VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

BRNO UNIVERSITY OF TECHNOLOGY

FAKULTA ELEKTROTECHNIKY A KOMUNIKAČNÍCH TECHNOLOGIÍ

FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION

ÚSTAV JAZYKŮ

DEPARTMENT OF FOREIGN LANGUAGES

SIGNÁLY A SYSTÉMY - KOMENTOVANÝ PŘEKLAD SKRIPT

SIGNALS AND SYSTEMS - COMMENTED TRANSLATION OF TEACHING MATERIALS

BAKALÁŘSKÁ PRÁCE

BACHELOR'S THESIS

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VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA ELEKTROTECHNIKY A KOMUNIKAČNÍCH TECHNOLOGIÍ

Bakalářská práce

bakalářský studijní obor **Angličtina v elektrotechnice a informatice**

Ústav jazyků

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NÁZEV TÉMATU:

Signály a systémy - komentovaný překlad skript

POKYNY PRO VYPRACOVÁNÍ:

Analýza vlastního překladu kapitoly odborného textu z předmětu Signály a systémy do angličtiny, popis použitých metod překladu a výběr vhodného analytického rámce, na jehož základě budou popsány rozdíly a shody ve vyjádření odborné informace v obou jazycích.

DOPORUČENÁ LITERATURA:

Swales John M.: Genre Analysis, CUP 1990

Knittlová Dagmar: Překlad a překládání, Olomouc, 2015

Krhutová Milena: Parameters of Professional Discourse,Tribun EU, 2009

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předseda oborové rady

Abstrakt

Tato bakalářská práce je zaměřena na překlad a analýzu studijních materiálů odborného zaměření z českého do anglického jazyka. Materiály, které jsou v rámci této práce přeloženy, se týkají předmětu Signály a Systémy a budou využívány na Fakultě elektrotechniky a komunikačních technologií Vysokého učení technického v Brně. První část práce se zaměřuje na překlad zvolené části odborných materiálů s důrazem na použitou terminologii. Překlad je prováděn s ohledem na jeho další použití v pedagogickém procesu a zároveň s cílem dosáhnout co největší shody s originálním textem. Druhá část práce se věnuje analýze jazykových prostředků pomocí zvolených jazykovědným disciplín. Tato analýza má za cíl zdůraznit důležitost a komplexnost procesu překladu odborných textů, který vyžaduje nejen znalost obou jazyků, ale také důkladné porozumění studované disciplíně.

Klíčová slova

signály, jednotkový skok, Diracův impuls, frekvence, překlad, analýza

Abstract

This bachelor thesis is focused on the translation and analysis of professional study materials from Czech to English. The materials translated within this work pertain to the course Signals and Systems, and will be utilized at the Brno University of Technology, Faculty of Electrical Engineering and Communication. The first part of this thesis focuses on translating selected excerpt of the teaching materials with an emphasis on the used terminology. The translation is carried out with consideration of its further use in the educational process and with the aim to achieve the greatest possible correspondence with the original text. The second part of the thesis deals with the analysis of language means using selected linguistic disciplines. This analysis aims to emphasize the importance and complexity of the process of translating professional texts, which requires not only knowledge of both languages but also a thorough understanding of the studied discipline.

Key words

signals, unit step, Dirac delta function, frequency, translation, analysis

Rozšířený abstrakt

Hlavním cílem této práce je překlad s důrazem na přesnost a správnost použití specializované terminologie. Je obecně známo, že angličtina je univerzálním jazykem pro komunikaci na mezinárodní úrovni. Angličtina, fungující jako globální lingua franca, má nezpochybnitelný vliv na mnoho oblastí lidské činnosti, což má obrovský dopad také v oblasti akademické sféry a studia, kde je dostupnost studijních materiálů v angličtině klíčová pro efektivní předávání a získávání znalostí.

Stále rostoucí globalizace a technologický rozvoj znamenají, že studenti mají přístup k obrovskému množství informací. Proto je zvlášť důležité, aby co nejvíce těchto informací bylo přístupných ve světovém jazyce, jako je angličtina. Díky tomu mají studenti více možností se učit, rozšiřovat své obzory a přispívat ke svému odbornému růstu.

S ohledem na celosvětovou rozšířenost anglického jazyka je právě angličtina tím jazykem, který umožňuje lidem přistupovat k co nejširšímu spektru informací. To platí zejména v technických a vědeckých oborech, kde je přesná terminologie zásadní pro správné porozumění a komunikaci konceptů a myšlenek.

Tato práce se zaměřuje na část ze studijního materiálu *Signály a systémy Část 1: Spojité signály,* který je vytvořený Prof. Ing. Pavlem Jurou, CSc., zvolená část pojednává o signálech a systémech, konkrétně o kapitole *Spojité signály a jejich analýza*. Materiál uvádí základní koncepty, jako jsou spojité a diskrétní signály a systémy. Následně se podrobně zabývá různými typy spojitých signálů, jako jsou například jednotkový skok nebo Diracův impuls. Dále tato část prozkoumává manipulaci s těmito signály a jednotlivé úkoly v prostředí MATLABu. Tento studijní materiál je primárně určen pro studenty Fakulty elektrotechniky a komunikačních technologií, Vysokého učení technického v Brně. Text byl zvolen vzhledem k žádosti Ing. Miroslava Jirgla Ph.D. právě proto, že zatím není přeložen, i přes jeho potenciální využití pro zahraniční studenty.

Struktura práce se dělí na dvě hlavní části. První část zahrnuje překlad výše zmíněného výňatku z odborného učebního materiálu na téma signály a systémy. Zde byl kladen důraz na přesný překlad specializované terminologie za pomoci dostupných zdrojů, slovníků a materiálů a znalostí z anglicky vyučovaného kurzu Signals and Systems. Technický překlad je náročná disciplína, která vyžaduje od překladatele alespoň základní znalosti tématu, jež se překládá. Absolvování již zmíněného kurzu Signals and Systems tak představovalo významnou výhodu.

Druhá část práce je věnována analýze překladu, která je rozčleněna do tří hlavních částí - analýzy textu na gramatické úrovni, sémantiké úrovni a také diskurzu, přičemž každá z nich hraje v překladu klíčovou roli a poskytuje jedinečný pohled na jednotlivé texty i samotný proces. K procesu samotnému náleží také podkapitola procesu překladu, kde jsou diskutovány problematické pojmy a způsoby jejich překladu.

Analýza gramatiky se zabývá čtyřmi klíčovými aspekty. Prvním aspektem je frekvence slovních druhů, kde je zkoumána četnost jednotlivých druhů slov a frází v textu. Druhým aspektem je lexikální hustota, která se týká počtu lexikálních slov vzhledem k celkovému počtu ve větě. Třetí aspekt se zabývá typy vět použitých v textu. Je zde analyzováno, zda text obsahuje například věty rozkazovací, oznamovací, nebo věty tázací, ke kterým jsou uvedeny i konkrétní příklady. Posledním, čtvrtým aspektem jsou ukazatelé formality, které zahrnují například použití definic, matematických výrazů a výskyt trpného a činného rodu, což napomáhá určit charakter textu.

Následuje semantická analýza, která je rozdělena do tří částí. První část se zaměřuje na srozumitelnost a schopnost textu předávat informace bez citového zabarvení. Dále se zde hodnotí jednotlivé symboly, matematické rovnice a odkazy na obrázky, u kterých je důležitá soudržnost s originálním textem. Druhá část se zabývá lexikálními vztahy, tedy vztahy mezi slovy a frázemi v textu, jako jsou synonyma, antonyma a další. V závěru semantické analýzy je zmíněno užití jazykových prostředků v technických textech, konkrétně tropů, což jsou nepřímá pojmenování skutečnosti, či zvláštní jazykové obraty.

Analýza na úrovni diskurzu je také rozdělena do tří částí. Zaměřuje se na kohezní a spojovací prostředky, které napomáhají plynulosti a soudržnosti textu. Druhá část této analýzy se zabývá strukturou textu, tedy jak je text organizován a jak jsou jednotlivé části propojeny. Poslední část se zaměřuje na intertextualitu, což znamená, že se zabývá vztahy mezi textem a jinými texty, a zkoumá, jak jsou citace, odkazy a jiné formy intertextové komunikace začleněny do textu.

Tyto tři hlavní body představují komplexní přehled o kvalitě a přesnosti překladu, a umožňují tak posoudit, jak dobře překlad zachovává význam původního textu a jak je přístupný pro čtenáře. Ve všech třech případech byl vždy uveden teoretické základ, který byl poté často doplněn o ukázky konkrétních příkladů z přeloženého, nebo originálního textu. Tato práce tak přispívá k rozšíření dostupných překladů technických materiálů určených k výuce na univerzitě.

FLUKSA, Daniel. *Signály a systémy - komentovaný překlad skript* [online]. Brno, 2023 [cit. 2023-05-25]. Dostupné z: https://www.vut.cz/studenti/zav-prace/detail/151492. Bakalářská práce. Vysoké učení technické v Brně, Fakulta elektrotechniky a komunikačních technologií, Ústav jazyků. Vedoucí práce Mgr. Petra Zmrzlá, Ph.D.

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Téma závěrečné práce:	Signály a Systémy - komentovaný překlad skript

Prohlašuji, že svou závěrečnou práci jsem vypracoval samostatně pod vedením vedoucí/ho závěrečné práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

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podpis autora

I would like to express my deepest gratitude to my supervisor Mgr. Petra Zmrzlá, Ph.D., for her patience, ideas, guidance, and, most importantly, for the valuable advice she provided during the writing of my bachelor thesis. I would also like to thank my beloved fiancée, Bc. Pavlína Kopková, for her unwavering support and patience. Lastly, my thanks go to Ing. Miroslav Jirgl, Ph.D., for generously providing me with the textbook that allowed this thesis to be written.

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1 Introduction

It is a well-known fact that over the years, English has become a globally used language for communication, translation, and education; in other words, it has become a *lingua franca*. Also called trade or even global language, it refers to English being used as a common means of communication by speakers worldwide, not only by those for whom it is the mother tongue. "Unlike any other language, past or present, English has spread to all five continents and has become a truly global language" (Nordquist 2020a). The significance of English in scientific disciplines is elevated further through its use for international cooperation and in the education of future engineers and scientists, underscoring its relevance.

This paper primarily focuses on the accuracy of technical terminology and the effective use of translation techniques. The popular opinion is that the translation of technical texts is easier to perform than the translation of literature, such as poetry or drama. The syntax of scientific texts is simpler, and the language used lacks emotions, which leads to these opinions. The reality is the exact opposite. The simplicity of the language is only apparent; a professional text is much less comprehensible and accessible. It also requires perfect knowledge of the language and at least basic knowledge of the orientation field. A translator with insufficient knowledge can commit so-called faux-amis or, in other words, a mistranslation (Knittlová 2010:203).

The first part of the thesis is devoted to the translation of an excerpt from the university textbook written by Prof. Ing. Pavel Jura, CSc., titled *Signály a systémy - Část 1: Spojité signály*. The textbook's original is written entirely in Czech and is used as a teaching material for the course 'Signály a systémy' at the Brno University of Technology, Faculty of Electrical Engineering and Communication. The focus of this textbook is on signals and systems. The chosen excerpt is concretely the Signals and Systems with Continuous-time signals and their analysis.

However, this thesis goes beyond merely translating the text. The subsequent sections will involve a comprehensive analysis of the translated content at various levels – from grammatical analysis to semantic and discourse/textual level analysis. This examination aims to underline the complexity of translating technical texts, considering the different linguistic and textual aspects. Finally, the thesis will delve into the translation process itself, reflecting on some challenges, and solutions that emerged during the work. This approach underscores the complex task of technical translation and the multitude of factors that must be considered to produce an accurate, coherent, and comprehensible translation.

2 Translation

1.1 Introduction and motivation

We encounter the terms "signal" and "system" almost daily without realizing it. For example, when we make a phone call, our voice (an acoustic signal) is picked up by a microphone (i.e., the system) into an electrical signal. This electrical signal is then transmitted, e.g., over a metallic line to the opposite station, where it is again converted by the loudspeaker (again, a system) back to the acoustic signal. This situation is shown in the left part of **Fig. 2-1**. The right part of the figure indicates the time waveform of both the acoustic and electrical signals. These signals are defined for all time instants (for a continuous segment on the time axis) and are, therefore, called ***continuous-time signals*** or ***continuous signals*** for short. Systems occurring in this block-diagram process these continuous signals and are consequently called ***continuous-time systems*** or simply ***continuous systems***.

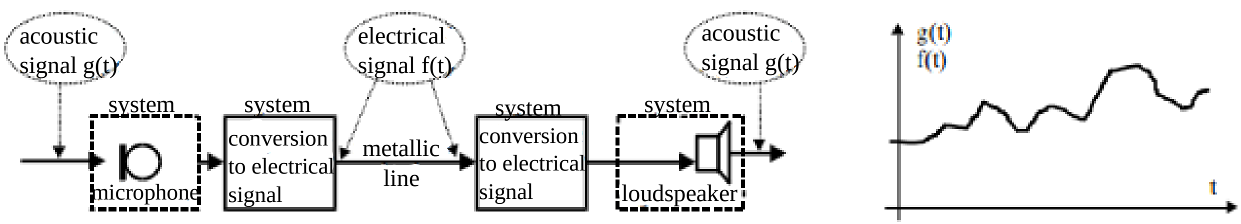


Fig. 2-1: Continuous-time signals and systems

Continuous signals are often converted into a discrete form using so-called sampling, i.e., from the continuous signal, samples are taken at regular intervals T (switch in **Fig. 2-2** switches at regular time intervals for a short moment). These samples may be further processed, transferred, or stored (e.g., in computer memory or on CDs) in digital form as a sequence of numbers. The situation, in this case, is shown schematically in **Fig. 2-2**. Such sampled signals are not (unlike continuous signals) defined over a continuous time period but are defined only in a discrete set of sampling instants kT $k = 0,1,2,...$ and are, therefore, called ***discrete-time signals*** or ***discrete signals*** for short. The systems by which these discrete-time signals are processed are called ***discrete-time systems*** or simply ***discrete systems***.

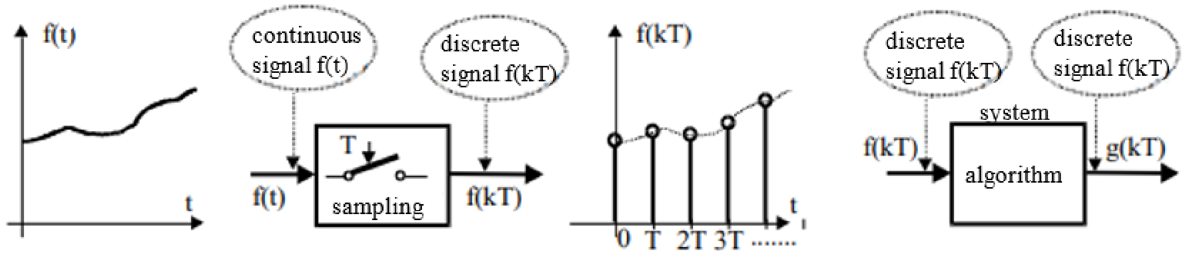


Fig. 2-2: Discrete-time signals and systems

A discrete system is basically an algorithm working with a sequence of numbers (the sampled values of the signal *f(kT)* $k = 0,1,2,...$). This algorithm is often implemented on some computer or microprocessor, and its resulting values (the output of the discrete system) are again a discrete signal, i.e., a sequence of numbers.

Signals and systems theory has numerous applications in various fields. Often systems (both continuous and discrete) are used to control multiple physical devices or systems. One such example for all is given in the following **Fig. 2-3.** This example represents what is called programmable temperature control in a room. For the reasons of economy (the room is used only at certain times of the day), the temperature in the room during the day should have a time course such as that indicated in the figure. The actual room temperature is measured by a thermometer whose signal (temperature reading υ [*°C*]) is converted into an electrical signal (again by a system consisting of a physical quantity transmitter). This signal is then discretized (i.e., converted to a number stored in the computer) using an analog-to-digital converter A/D (usually part of a microcomputer). This value, measured (more precisely, discretized) at time instants kT $k = 0,1,2,...$enters the algorithm (into the discrete system, implemented by the microcomputer program). Furthermore, the desired value (obtained for a given time instant kT $k = 0,1,2,...$from the desired temperature time course) enters the algorithm at the same time instants. The algorithm's output (the output of the discrete system) then controls the solenoid valve SV utilizing a power element that controls the amount of heating water passing through the heater.

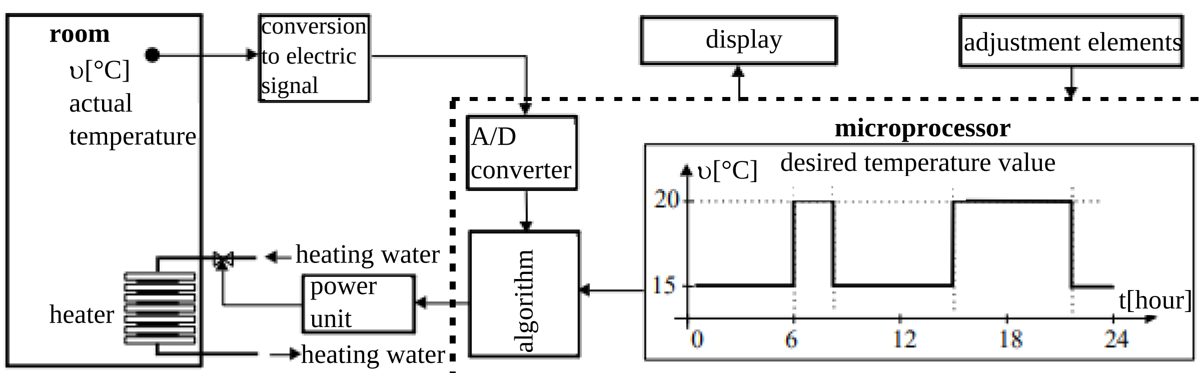


Fig. 2-3: Programmable temperature control in a room

The following chapter studies the fundamental properties of both continuous and discrete signals and continuous and discrete systems.

1.2 Course classification in the study program

The course Signals and Systems is included in the third semester of the bachelor's degree program *Electrical Engineering, Electronics, Communication, and Control Engineering*. It builds on the courses *Electrical Engineering 1* and *Electrical Engineering 2* and partly on *Physics 1* and *Physics 2*. The prior knowledge required for the study of this course is mainly knowledge of differential, and integral calculus of functions of one variable, basic knowledge of Laplace and Fourier transforms, and elementary knowledge of matrix calculus. This knowledge is the content of the courses *Mathematics 1*, *Mathematics 2, and Mathematics 3* of the study program mentioned above.

1.3 Introduction to the course

The student will learn how to mathematically describe continuous and discrete signals and perform various operations on these signals. In addition, the student will learn the timing and frequency representation of the signal. In the following chapters, they will learn about systems, both continuous and discrete, and how the properties of a signal change as it passes through a system.

1.4 Entry test (to be done)

The placement test is designed to be self-evaluated by the student. Its purpose is to verify the student's prior knowledge necessary to complete the study presented in the course text. The placement test key must be in the appendices at the end of this study material.

2 Continuous signals and their analysis

2.1 Basic continuous signals and their properties

In the introductory chapter, we introduced the concept of a continuous-time signal or a continuous signal in simplified form. For further processing of such a signal, we must describe it by some mathematical means. These mathematical means are the notion of a function defined on the entire real axis. In fact, no real signal can start at minus infinity and last to plus infinity. Since we will further process the signals mathematically, it is, in terms of mathematics, appropriate to consider the following domain of a function $f(t)$. It is, therefore, a mathematical model of the continuous signal function $f(t)$, $t \in (-\infty, +\infty)$.

2.1.1 Basic continuous signals

One of the basic continuous signals is the so-called ***unit step*** $\sigma(t)$. It is defined by the following relation:

$$\sigma(t)=\begin{cases}1 & t\geq 0\\ 0 & t<0\end{cases} \tag{2.1}$$

and its waveform is shown in the left part of **Fig. 2-1**. The right part of this figure shows a similar signal $\sigma(t,\varepsilon)$, which is defined as

$$\sigma(t,\varepsilon)=\begin{cases}0 & t\leq -\varepsilon/2\\ t/\varepsilon+0{,}5 & t\in(-\varepsilon/2,+\varepsilon/2)\\ 1 & t\geq +\varepsilon/2\end{cases} \tag{2.2}$$

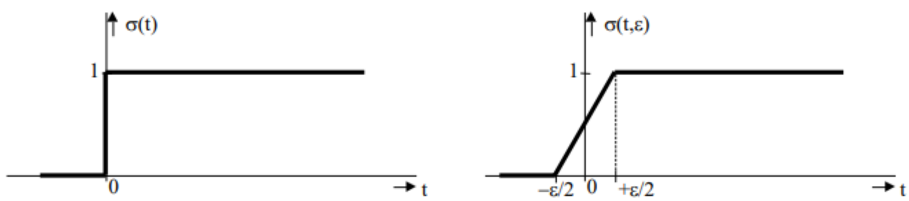


Fig. 2-1: Unit step

It is clear from the figure that if the parameter ε nears the value of zero, the function $\sigma(t,\varepsilon)$ will become a unit step, i.e., function $\sigma(t)$. Mathematically expressed as

$$\lim_{\varepsilon\to 0}\sigma(t,\varepsilon)=\sigma(t) \tag{2.3}$$

An example of a unit step type signal can be the connection of a 1-volt DC voltage source to an appliance at time t = 0.

Another basic signal is the so-called ***Dirac delta function*** or simply ***Dirac delta*** $\delta(t)$ (P.A.M. Dirac, 1902- 1984, English theoretical physicist). It is defined by the following relation:

$$\delta(t)=\begin{cases}0 & t\neq 0\\ +\infty & t=0\end{cases} \quad \text{and at the same time} \quad \int_{-\infty}^{+\infty}\delta(t)dt=1 \tag{2.4}$$

i.e., its area is equal to 1. Its waveform is shown in the left part of **Fig. 2-2**. The right part of this figure shows the signal $\sigma(t,\varepsilon)$, which has the shape of a narrow and high impulse and is defined as

$$\delta(t,\varepsilon)=\begin{cases}0 & t\notin\langle-\varepsilon/2,+\varepsilon/2\rangle\\ 1/\varepsilon & t\in(-\varepsilon/2,+\varepsilon/2)\end{cases} \tag{2.5}$$

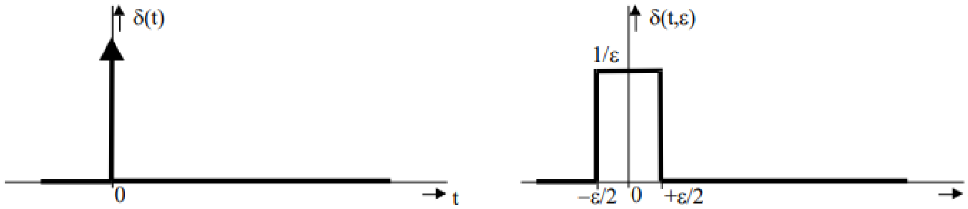


Fig.2-2: Dirac delta

It is clear from the figure that if the parameter ε approaches zero value, the function $\delta(t,\varepsilon)$ becomes a Dirac delta, i.e., a function $\delta(t)$. Expressed mathematically as

$$\lim_{\varepsilon\to 0}\delta(t,\varepsilon)=\delta(t) \tag{2.6}$$

The execution of the Dirac delta is not possible. However, we can implement signal S. An example of this type of signal would be to connect a high-voltage DC source to an appliance for a brief period so that the area of such an impulse is unity.

Unit ramp signal (linearly increasing signal) is another basic signal. Its time waveform is shown in **Fig. 2-3** on the left. This signal is defined as

$$r(t)=\begin{cases}t & t\geq 0\\ 0 & t<0\end{cases} \tag{2.7}$$

The build-up speed of this signal (derivative $f'(t)\, t>0$) is unity. Signal $ar(t)$ will have a build-up speed equal to a. Similarly, a quadratically increasing signal can be defined as t^2 for $t\geq 0$ and 0 for $t<0$. In the general case, we can determine the signal by a polynomial

$$f(t)=\begin{cases}b_0+b_1t+\ldots+b_nt^n & t\geq 0\\ 0 & t<0\end{cases} \tag{2.8}$$

It is clear that the unit step, the unit ramp, and the quadratically increasing signal are special cases of this general signal.

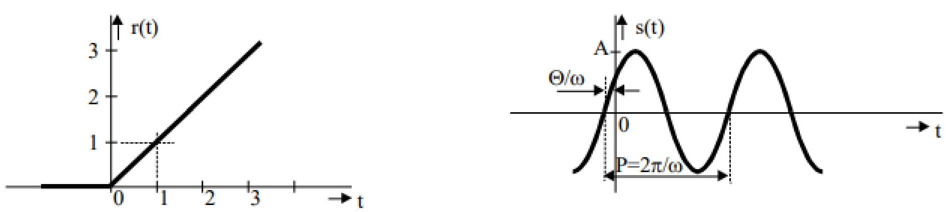


Fig. 2-3: Unit ramp signal (left) and sinusoidal signal (right)

The sinusoidal signal is one of the periodic signals that form an important group of signals. A signal with continuous time (continuous signal) $s(t)$ is called ***periodic*** with ***period*** P if

$$s(t) = s(t + P) \tag{2.9}$$

for all t. If this relation is true, then it also applies

$$s(t) = s(t + P) = s(t + 2P) = \cdots = s(t + nP) \tag{2.10}$$

for any integer n. So, if the signal is periodic with a period P, then it is also periodic with periods $2P$, $3P$... The smallest value of the period P is called the ***fundamental period***, and the function then repeats every P seconds.

The most important periodic signal is the ***sinusoidal signal***. It is mathematically described by the function

$$s(t) = A\sin(\omega t + \Theta) \tag{2.11}$$

and is shown in **Fig. 2-3**. on the right. The sinusoidal signal is periodic with a fundamental period

$$P = 2\pi / \omega \tag{2.12}$$

The fundamental period is the shortest interval in which the sinus rhythm repeats to form a complete cycle. The reciprocal value of this period $f = 1/P$, therefore, determines the number of these cycles per second and is called ***frequency***, and the unit is ***hertz*** [*Hz*]. One hertz is one cycle per second. Quantity

$$\omega = 2\pi f \tag{2.13}$$

is called ***angular frequency***, and its unit is radian per second [*rad /sec*]. A sinusoidal signal with a frequency of 1000 Hz has a fundamental period of 1/1000=1 millisecond and an angular frequency of $2 \cdot \pi \cdot 1000 = 6282$ *rad/sec.*

A real exponential function is defined as

$$f(t) = e^{at} \qquad t \in (-\infty, +\infty) \tag{2.14}$$

where a is a real number. If $\alpha > 0$, then the exponential function increases from 0 over all limits as t increases from $-\infty$ to $+\infty$ as shown in the left part of **Fig. 2-4.** If $\alpha < 0$, then the exponential function decreases from $-\infty$ to 0 as t grows from $-\infty$ to $+\infty$, as shown in the right part of **Fig. 2-4.**

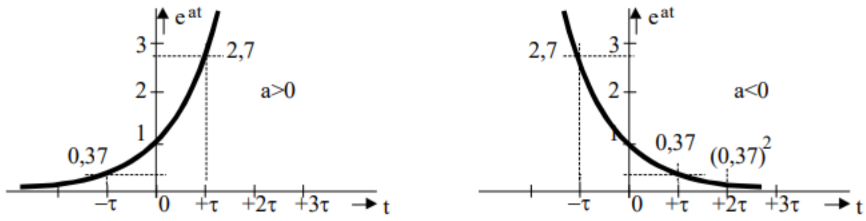


Fig. 2-4: Real exponential function

The value of *a* gives the rate of increase or decrease of a real exponential function. The reciprocal value of the absolute value of this number is called the time constant $\tau = 1/|\alpha|$. Its physical dimension is the second. If time increases by this time constant, then the real exponential function will increase (for $\alpha > 0$) or decrease (for $\alpha < 0$) as follows

$$\frac{f(t+\tau)}{f(t)} = \frac{e^{a(t+\tau)}}{e^{at}} = e^{a\tau} = e^{\frac{a}{|a|}} = \begin{cases} e^{+1} = 2{,}7 & a > 0 \\ e^{-1} = 0{,}37 & a < 0 \end{cases} \tag{2.15}$$

This means that, for example, for $\alpha < 0$, the function drops to 37% of its original value.

Complex exponential function. So far, we have been dealing with signals whose values were real numbers. Now we will deal with a signal whose values are complex numbers. Such a basic signal is the complex exponential function

$$f(t) = e^{j\omega t} t \in (-\infty, +\infty) \tag{2.16}$$

where W is a real number (angular frequency) and $j = \sqrt{-1}$ is a complex unit. The so-called ***Euler's formula*** (after the Swiss mathematician Euler, 1707-1783) applies

$$e^{j\omega t} = \cos\omega\,\mathrm{t} + j\,\sin\omega\,t \quad t \in (-\infty, +\infty) \tag{2.17}$$

Given the fact that

$$\left|e^{j\omega t}\right| = \sqrt{(\cos\omega t)^2 + (sin\omega t)^2} = 1 \tag{2.18}$$

the expression $e^{j\omega t}$ can be imagined as a unit vector rotating in the complex plane with angular velocity ω. The axis projections of this vector onto the real and imaginary axes represent the real and imaginary parts of the complex signal $e^{j\omega t}$. The situation is shown in **Fig. 2-5** on the left. Let us create a vector to this vector (signal) that rotates in the complex plane in the reverse direction (this signal has a ***negative frequency***) i.e.,

$$e^{-j\omega t} = \cos\omega\,\mathrm{t} - j\,\sin\omega\,t \quad t \in (-\infty, +\infty) \tag{2.19}$$

By adding or subtracting these two vectors, we obtain important relations

$$cos\omega t = \frac{e^{j\omega t} + e^{-j\omega t}}{2} \qquad\qquad sin\omega t = \frac{e^{j\omega t} - e^{-j\omega t}}{2j} \tag{2.20}$$

This situation is shown in **Fig. 2-5** on the right.

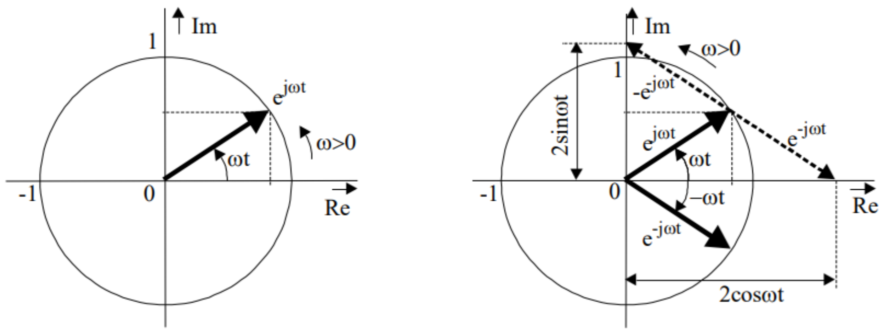


Fig. 2-5: Complex exponential signal

Task 2.1: *Complex exponential signal*

Plot the vector in the complex plane e^{j2t} for $t = 0,1, \pi / 2, \pi$, 4. Plot the same vector for the same but negative frequencies.

2.1.2 Signal boundedness in amplitude and finiteness in time

A continuous signal $f(t)$ is called ***bounded in amplitude*** in the time interval (a,b) if there exists a real constant M such as

$$|f(t)| < M \qquad t \in (a,b)$$

The specification of the time interval is essential. For example, a real exponential signal $e^{\alpha t}$ with parameter $\alpha < 0$ is bounded in the interval $(0, +\infty)$ but not bounded in the interval $(-\infty, +\infty)$.

In the real world, all signals are bounded. For example, an operational amplifier can generate a unit ramp signal or an exponential signal. However, such an amplifier is always supplied with a finite voltage, e.g., ±15[V]; therefore, the signal generated by it is limited by this value $M = 15$. The operational amplifier will ***saturate*** when generating a unit ramp or exponential signal.

In the previous text, we have often used the definition interval $(-\infty,+\infty)$ for our signals. Infinity is a mathematical concept instrumental in mathematics. In the real world, every signal begins and ends at a finite point in time, i.e., it is ***finite in time***. For example, a time interval of 10^{100} seconds (that is approximately $3 \cdot 10^{92}$ years) is certainly much smaller than a mathematical infinity. However, from the observer's point of view, it can be considered infinite. In engineering applications, we often work with numerically much smaller intervals than this astronomical number and yet can be considered as infinity. For example, a decreasing exponential signal $e^{-t/\tau}$ will drop over a period of five time constants τ to a value of $(0.37)^5 = 0.007$, which can already be considered zero, and therefore, in this case $\infty \approx 5\tau$.

Task 2.2: *The real infinity*

Let us assume that the $e^{-t/\tau}$ signal reaches zero in 5 time constants τ. Which time instant can be considered infinite if τ = 100,1, 0.01 seconds?

Key: 500, 5, 0,05 sec.

2.1.3 Operations with continuous signals

In this chapter, we will learn about two simple operations with continuous signals.

Shifting of a signal in time (time shifting). Let there be a signal $f(t)$ and a positive real number T. Then the signal $f(t - T)$ is a signal that has the same waveform as the original signal f (t) but is shifted in time by T seconds to the right (this new signal is delayed by T seconds). The situation is shown in the middle of Fig. 2-6 for $T = 1$.

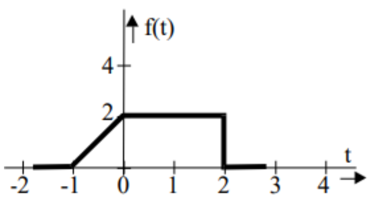


Fig.2-6: Shifting of a signal in time

Similarly, a signal $f(t + T)$ is a signal with the same waveform as the original signal $f(t)$ but is shifted in time by T seconds to the left (this new signal is ahead by T seconds). The situation is shown in the right part of **Fig. 2-6** for $T = 1$.

Flipping of the time axis (time axis flipping). Let $f(t)$ be the same signal as in **Fig. 2-6** on the left. Then $f(-t)$ is the flipped signal relative to the beginning of the time axis $t = 0$ and is shown in **Fig. 2-7** on the left.

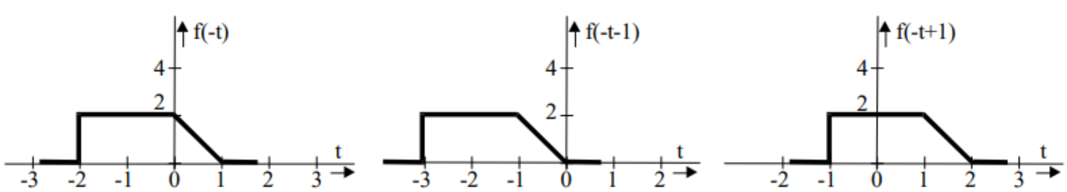


Fig.2-7: Flipping of the time axis and shifting of a signal in time

If $T > 0$, then $f(-t - T)$ shifts the signal $f(-t)$ to the left by T seconds since $f(-t - T) = f[-(t + T)]$ see **Fig. 2-7** in the middle. Conversely, $f(-t+T)$ shifts the signal $f(-t)$ to the right by T seconds since $f(-t + T) = f[-(t - T)]$ see **Fig. 2-7** on the right.

Signal multiplication. Consider two signals $f(t)$ and $h(t)$, defined for all $t \in (-\infty, +\infty)$. Then the multiplication of these signals produces a new signal $g(t) = f(t)h(t)$. If $h(t)$ is a constant signal $h(t)=A$ for all $t \in (-\infty, +\infty)$, where A is a real positive number greater than 1, then the signal $g(t)$ is an amplified signal $f(t)$. An example is shown in **Fig. 2-8**, on the left, for $A = 2$. The original signal $f(t)$ is the signal in **Fig. 2-6**, on the left, and the resulting signal $g(t)$ is amplified twice. The signal will be attenuated if A is a positive number but less than 1. The signal will be inverted if A is a negative number (see **Fig. 2-8** on the right).

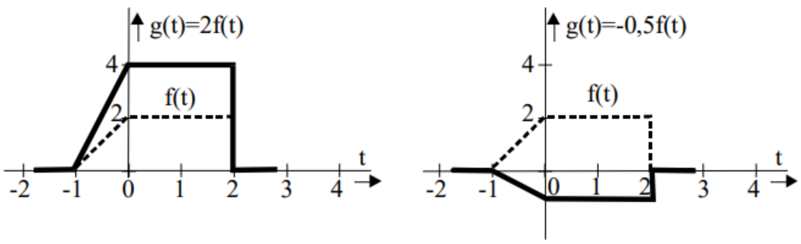


Fig.2-8: Signal amplification (on the left) and signal inversion (on the right)

If the signal $h(t)$ is equal to the unit step, i.e., $h(t) = \sigma(t)$, the result of the multiplication will be the signal $f_+(t) = f(t)\sigma(t)$. If the signal $h(t)$ is equal to the inverted unit step, i.e., $h(t) = \sigma(-t)$, the result of the multiplication will be the signal $f_-(t) = f(t)\,\sigma(-t)$, thus

$$f_+(t) = \begin{cases} f(t) & t \geq 0 \\ 0 & t < 0 \end{cases} \qquad f_-(t) = \begin{cases} f(t) & t \leq 0 \\ 0 & t > 0 \end{cases} \tag{2.22}$$

The situation is shown in Fig. 2-9. In this case, the multiplication operation "carves" (truncation) the positive or negative part of the original signal f (t).

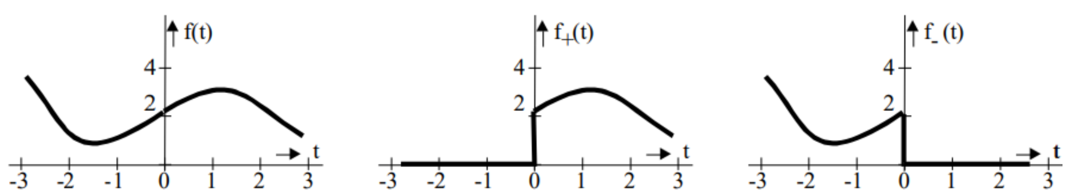


Fig.2-9: Clipping of positive and negative part of the signal

If the signal h(t) is a rectangular pulse of unit amplitude, i.e.,

$$h(t) = \begin{cases} 1 & t \in \langle -a, +a \rangle \\ 0 & t \notin \langle -a, +a \rangle \end{cases} \tag{2.23}$$

only the part of the signal f (t) that lies in the interval $\langle -\alpha, +\alpha \rangle$ will be cut out. The situation is shown in **Fig. 2-10**. Such a signal shape, $h(t)$, is called a ***window*** and is usually denoted by $w(t)$. In this case, it is a so-called rectangular window (sometimes known as the boxcar or

Dirichlet window). Windows are often used in signal processing and will be discussed later in the following chapter.

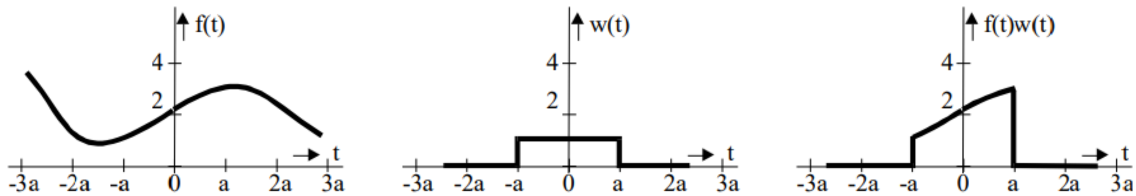


Fig.2-10: Truncation of part of the signal with a rectangular window

Let us return at this point to another property of Dirac's function. Let us shift the Dirac delta to the right by τ seconds. Let some continuous function $f(t)$, $t \in (-\infty, +\infty)$ be given. Since

$$f(t)\delta(t-\tau) = f(\tau)\delta(t-\tau)$$

will be the integral

$$\int_{-\infty}^{+\infty} f(t)\delta(t-\tau)dt = \int_{-\infty}^{+\infty} f(\tau)\delta(t-\tau)dt = f(\tau)\int_{-\infty}^{+\infty} \delta(t-\tau)dt = f(\tau).$$

We have therefore received the following result

$$\int_{-\infty}^{+\infty} f(t)\delta(t-\tau)dt = f(\tau). \qquad (2.24)$$

This relationship is called the ***filtering property*** of the Dirac function. It is filtering because the Dirac function $\delta(t-\tau)$ filters out only the value at point $t=\tau$ from all values of the function $f(t)$. We will be using this property often in the future.

Addition or subtraction (difference) of signals. Let us consider two signals $f(t)$ a $h(t)$ defined for all $t \in (-\infty, +\infty)$. Then the sum (difference) of these signals produces a new signal $g(t) = f(t) + h(t)$ resp. $g(t) = f(t) + h(t)$.

In the following tasks, create the desired signals using the previous signal operations.

Task 2.3: *Operations with basic signals 1*

By time shifting of the unit step $\sigma(t)$, create an impulse $f(t)$

$$f(t) = \begin{cases} 1 & t \in (-1, +1) \\ 0 & t \notin (-1, +1) \end{cases}$$

with unit amplitude and duration of 2 seconds, which is shown in the left part of **Fig. 2-11**.

It is clear from the figure that the following formula holds true

$$f(t)=\sigma(t+1)-\sigma(t-1).$$

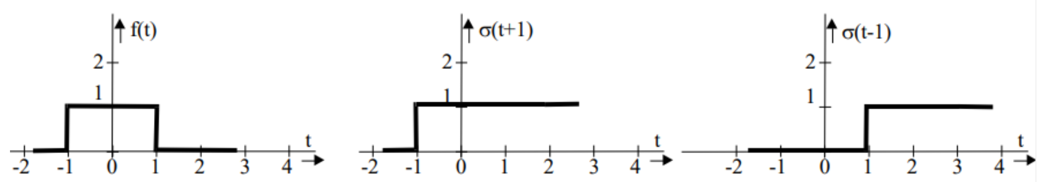


Fig. 2-11: Unit impulse and its construction using shifted $\sigma(t)$

Exercise 2.4: *Operations with basic signals 2*

Using the unit step $\sigma(t)$, flipping the time axis and multiplication operation, create the same signal as in the previous exercise. From **Fig. 2-12**, it is clear that the $f(t) = \sigma(t+1)\sigma(t+1)$ holds true.

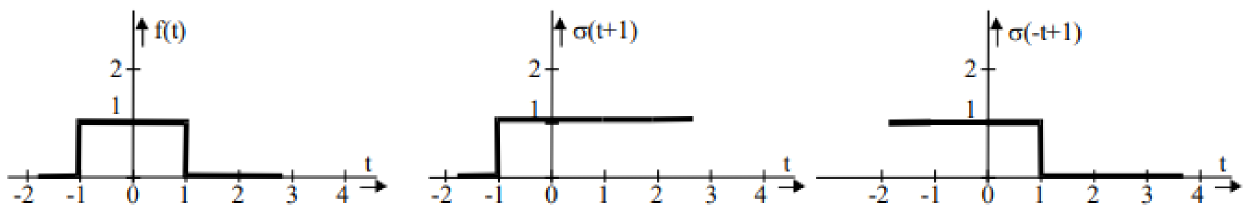


Fig. 2-12: Unit impulse-construction by multiplication of flipped and shifted $\sigma(t)$

Exercise 2.5: *Operations with basic signals 3*

Create a periodic signal $q(t)$ with period P, duration 2α, and amplitude A, shown in **Fig. 2-13**. Multiply the unit impulse $f(t)$, obtained in the previous exercise, by the amplitude A to create a copy of it, shifted by i ($i = \pm 1, \pm 2, \pm 3,...$) period P

$$f_i(t)=Af(t-iP)=A[\sigma(t+a+iP)-\sigma(t-a+iP)].$$

All so created copies are then summed with the original impulse ($i = 0$) and we get

$$q(t)=\sum_{i=-\infty}^{\infty} f_i(t)=A\sum_{i=-\infty}^{\infty}[\sigma(t+a+iP)-\sigma(t-a+iP)].$$

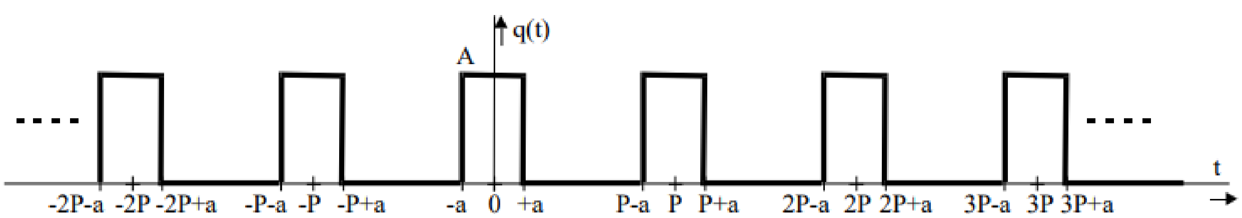


Fig. 2-13: Periodic impulse with amplitude A, duration $2a$ and period P

2.1.4 Summary of Chapter 2.1

1. Continuous-time signals (continuous signals) are defined for all $t \in (-\infty, +\infty)$. However, it is not mathematically necessary for the function $f(t)$ that describes the signal itself to be continuous (see, e.g., the unit step $\sigma(t)$ is a function that is not continuous at $t = 0$). A single signal value at an isolated point carries no information. Therefore, for example, the value of the unit step $\sigma(t)$ at point t = 0 may be defined as 1 or 0.

2. Among all the continuous signals, we can identify the basic signals to which we count unit step, Dirac delta function, unit ramp signal, sinusoidal signal, and real and complex exponential signal. The signals can be non-periodic (e.g., unit step, Dirac delta function, unit ramp signal, real exponential signal) or periodic (sinusoidal signal, complex exponential signal).

3. Various mathematical operations can be performed on the signals - time shifting, time axis flipping, multiplication, addition, and subtraction. These operations can be used for the creation of additional, more complex signals from basic signals.

2.1.5 Exercises for chapter 2.1

1. Let there be two signals $f_1(t)$, $f_2(t)$, see Fig. 2-14. Draw the signals $f_1(t+1)$, $f_1(t-2)$, $f_1(-t+2)$. What is the relationship between these two signals?

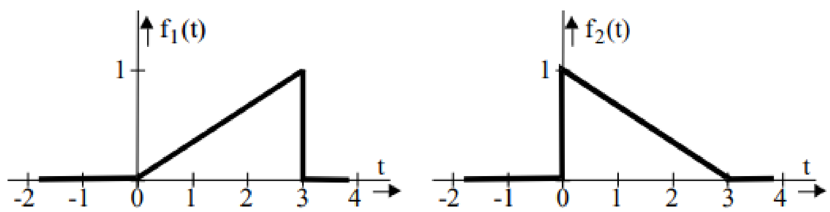


Fig. 2-14: Two signals for Exercise 1

2. Express the signals from the previous exercise using a unit step and unit ramp signal.

3. Express the signals in **Fig. 2-15** using a unit step and a unit ramp signal.

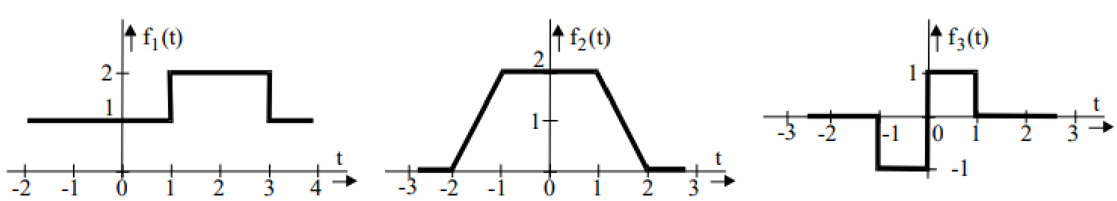


Fig. 2-15: Three signals for Exercise 3

4. A function $f(t)$ is called ***even*** if $f(t) = f(-t)$. A function $f(t)$ is called ***odd*** if $f(t) = -f(-t)$. Let a function $f(t)$ to be given and create two new functions

$$f_e(t) = \frac{f(t) + f(-t)}{2} \qquad f_o(t) = \frac{f(t) - f(-t)}{2}.$$

Prove that $f_e(t)$ is an even function and $f_o(t)$ is an odd function. Further prove that each function $f(t)$ can be expressed as the sum of its even and odd parts i.e., $f(t) = f_e(t) + f_o(t)$.

5. Is the function $\cos\omega_0 t$ an even or an odd function? What is its fundamental period? Is the function $|\sin\omega_0 t|$ an even or odd function? What is its fundamental period?

6. Three periodic signals are shown in **Fig. 2-16**. One-way rectified harmonic voltage (left), a two-way rectified harmonic voltage (middle) and a sawtooth waveform (right). Express them using the fundamental signals.

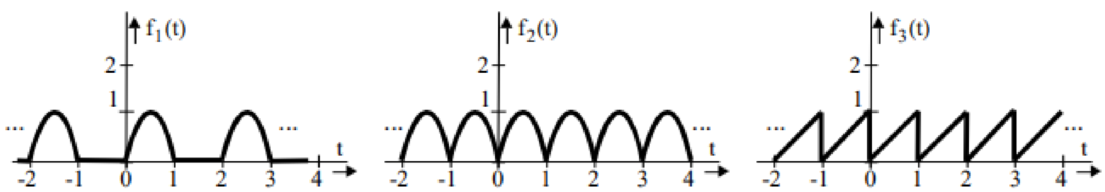


Fig. 2-16: Examples of periodic signals

7. Sketch the functions $f_1(t)=e^{-0.2t}$, $f_2(t) = \cos 4t$, $f_3(t)= f_1(t)f_2(t)$. Is the function $f_3(t)$ bounded in time? Discuss why. Which value of time can be considered a real "infinity" for this function (when the function value drops to 1% of its initial value).

2.1.6 MATLAB exercises for chapter 2.1

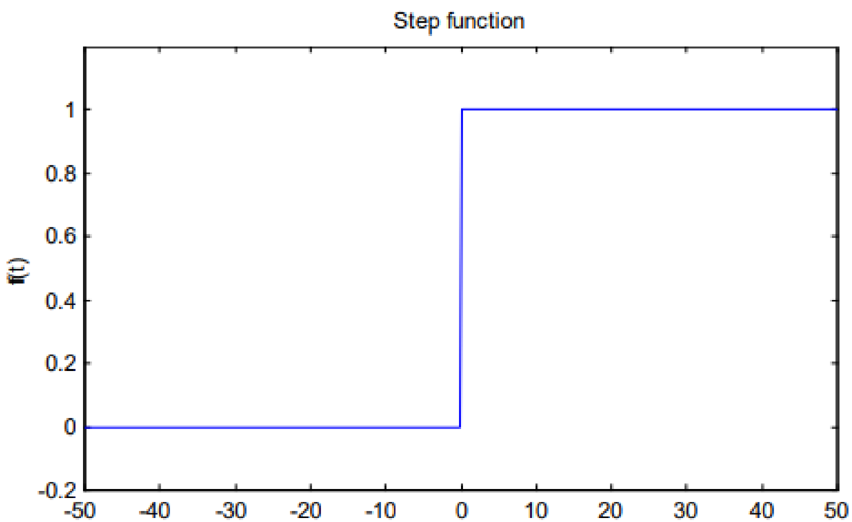
We are dealing with continuous-time signals (continuous signals for short). Such a signal is mathematically defined for all time instants of the real-time axis, i.e., for all real numbers on this axis. Such a signal cannot be represented in a digital computer. In a digital computer, a signal can only be represented as a finite sequence of signal values at specific points in time (usually equidistant). The time axis is, therefore, discrete, and the signal is sampled at these time instants for some finite time P. Let us denote the number of samples per this period as N. We are thus ahead in the explanation of the signals (sampling will be the filling of the following chapters), but without this, it would be impossible to implement the tasks in MATLAB. Let us create a discrete timeline using MATLAB commands:

```
P=100;                  % time interval [sec]
N=512;                  % number of samples
t=linspace(-P/2,P/2,N); % discrete time axis
```

Let us create a unit step type signal $\sigma(t)$ and display it:

```
name='Step function';
ft(1:N)=0;
ft((round(N/2)+1):N)=1;
plot(t,ft)
axis([-P/2 P/2 -0.2 1.2])
title(name);
xlabel('t');
ylabel('f(t)');
```

The result is the following waveform.



We will use this signal frequently in the future. Therefore, we will create it as a MATLAB function with the addition of a time offset of α seconds. So, we will have programmed the function $\sigma(t + \alpha)$, i.e., a shifted unit step:

```
% function StepFunction(t,a)
% t= time axis [sec]
% a= shift time [sec] (a<=max(t), a>=min(t))

function [ft]=StepFunction(t,a)
P=max(t)-min(t);                % observation time [sec]
N=length(t);                    % number of samples [-]
if abs(a)>P/2                   % limit of shift time [sec]
   a=sign(a)*P/2;
end;
ft=t;
ft(1:N)=0;
n=sign(a)*round(abs(a)*(N-1)/P); % a is real, n must be integer
ft((round(N/2)+1-n):N)=1;
return;
```

Save this program under the name "StepFunction.m". The first three lines are a comment that can be used to describe the behavior of the function and the meaning of the parameters. If you type in the MATLAB command window the following text

function StepFunction(t,a)

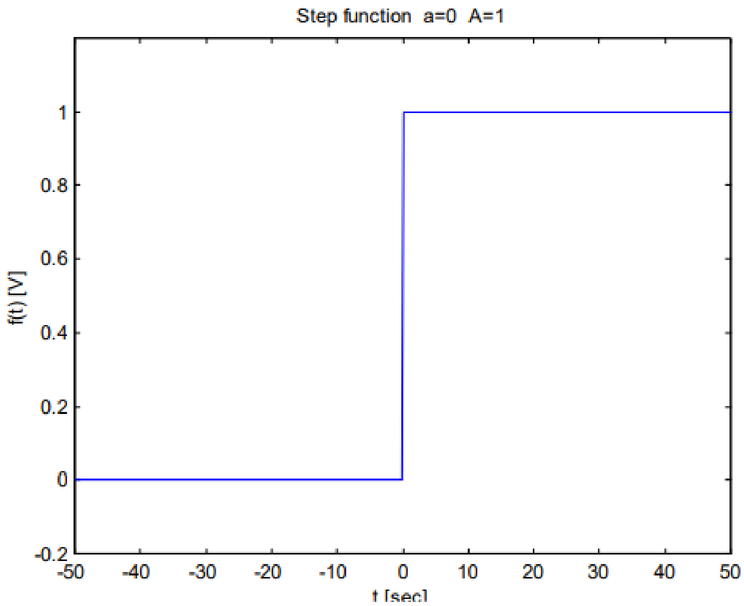
t= time axis [sec]

a= shift time [sec] (a<=max(t), a>=min(t))

Now we will run the StepFunction.m function. We will also create this execution as a function, which we will call StepFunctionPlot.m. We will assume that our signals represent a voltage waveform in volts. [*V*]. Thus

```
% function StepFunctionPlot(a,A)
% a= time shift [sec]
% A= amplitude [V]

function StepFunctionPlot(a,A);

P=100;                     % time interval [sec]
N=512;                     % number of samples [-]
t=linspace(-P/2,P/2,N);    % discrete time axis

name='Step function';
ft=A*StepFunction(t,a);
plot(t,ft)
axis([-P/2 P/2 -0.2*A 1.2*A])
title([name,'  a='num2str(a),'  A=',num2str(A)]);
xlabel('t [sec]');
ylabel('f(t) [V]');
return
```

and after executing the StepFunctionPlot(0,1) we get the previous figure. Run this function with different values of the parameter α or A, and observe the generated figures.



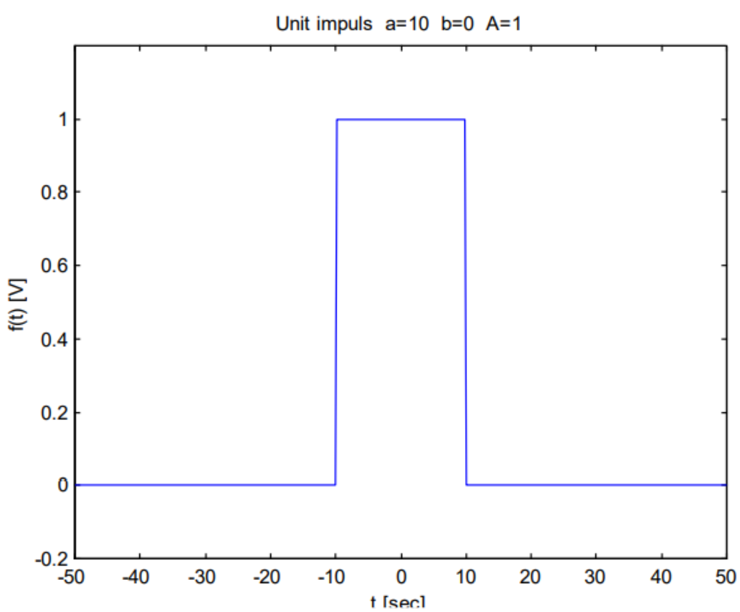
Now, using the "StepFunction.m" function, we create a unit impulse with width 2 α and center b using the time shifting operation and the difference of unit steps. Again, we will program this as a function named UnitImpuls.m since we will use it later. The code will be:

```
% function UnitImpuls(t,a,b)

% t=time axis [sec]
% a= half width of impuls [sec]
% b= centre of impuls [sec]

function [ft]= UnitImpuls(t,a,b);
P=max(t)-min(t);
if abs(b)>P/2                    % limit of impuls center
   b=sign(b)*P/2;
end;
ft=StepFunction(t,b+a)-StepFunction(t,b-a);
return
```

Program the execution of this function again as a function named UnitImpulsPlot.m. The code will be:

```
% function UnitImpulsPlot(a,b,A)
% a= half width of impuls [sec]
% b= center of impuls [sec]
% A= amplitude of impuls [V]

function UnitImpulsPlot(a,b,A);
P=100;                          % time interval [sec]
N=512;                          % number of samples
t=linspace(-P/2,P/2,N);         % discrete time axis

name=('Unit impuls');
ft=A*UnitImpuls(t,a,b);
plot(t,ft)
axis([-P/2 P/2 -0.2*A 1.2*A])

title([name,'  a='num2str(a),'  b=',num2str(b),'  A=',num2str(A)]);
xlabel('t [sec]');
ylabel('f(t) [V]');
return
```

and after running the UnitImpulsPlot(10,0,1) you get the following waveform. Run the function with different parameters and observe the resulting figure.



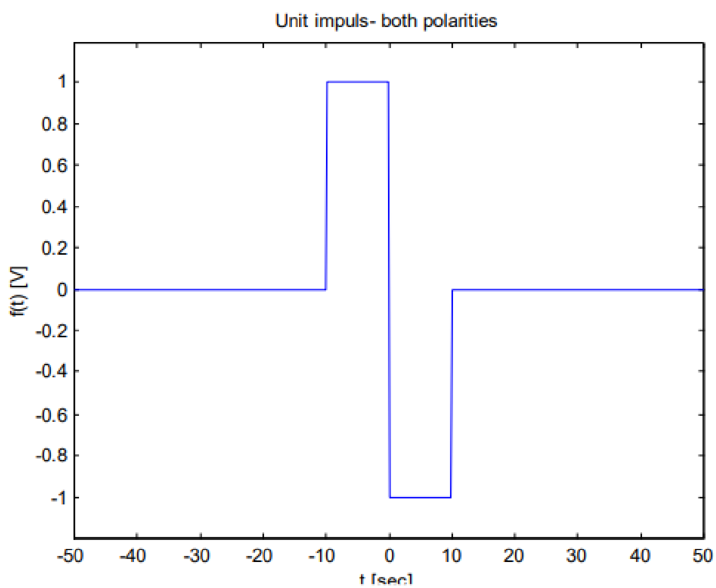
Note: This impulse can also be created by flipping the time axis and the multiplication as follows:

```
name='Unit impuls(use flip)'
a=10;
A=1;
ftp=A*StepFunction(t,a);        % shifted unit step
ftn=fliplr(ftp);                % flipping of ftp
```

```
ft=ftp.*ftn;                    % multiplication element-by-element
plot(t,ft)
axis([-P/2 P/2 -0.2*A 1.2*A])
title(name)
xlabel('t [sec]');
ylabel('f(t) [V]');
```

Let us create an impulse of unit amplitude having both polarities by unit step. The code will be:

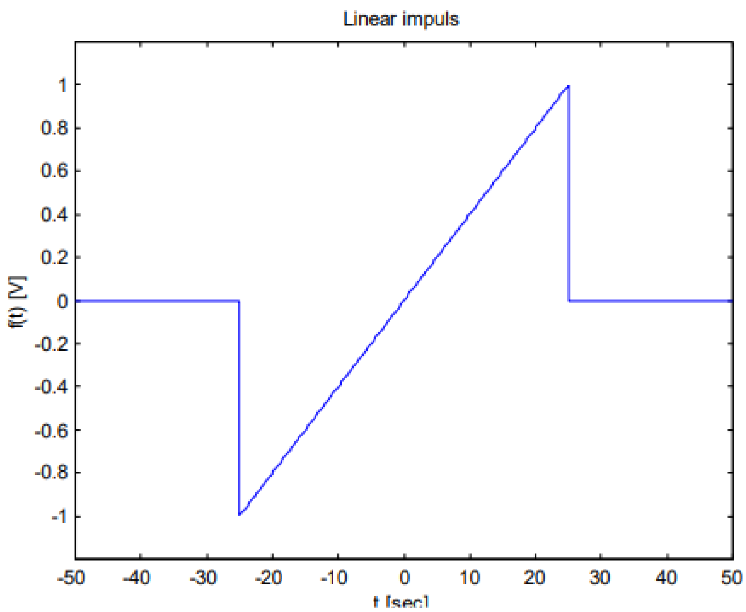
```
name='Unit impuls- both polarities'
a=10;
A=1;
ft=A*StepFunction(t,a)-2*A*StepFunction(t,0)+A*StepFunction(t,-a);
plot(t,ft)
axis([-P/2 P/2 -1.2*A 1.2*A])
title(name)
xlabel('t');
ylabel('f(t)');
```



Let us create a linear signal of duration 2 α. The code will be:

```
name='Linear impuls'
a=25;
ft=(A/a)*t;
ft=ft.*UnitImpuls(t,a,0);
plot(t,ft);
axis([-P/2 P/2 -1.2*A 1.2*A])
title(name)
xlabel('t [sec]');
ylabel('f(t) [V]');
```

and is shown in the following figure.



Another useful signal that we will create as a MATLAB function will be a triangular impulse, which we will call TriangleImpuls.m and program again as a function. The code will be:

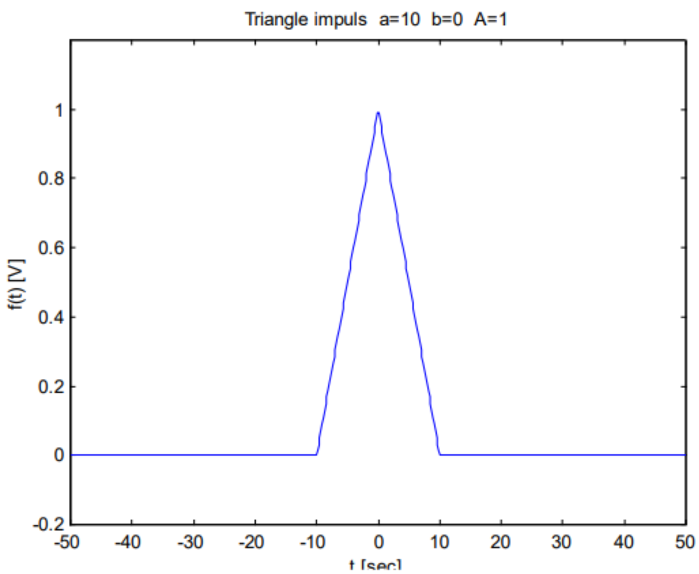
```
% function TriangleImpuls(t,a,b)
% t= time axis [sec]
% a= half width of impuls [sec]
% b= centre of impuls [sec]

function [ft] = TriangleImpuls(t,a,b);
P=max(t)-min(t);
if abs(b)>P/2                % limit of impuls center
   b=sign(b)*P/2;
end;

ftp=(1/a)*(t+b+a);
ftp=ftp.*(StepFunction(t,a+b)-StepFunction(t,b));
ftn=(1/a)*(-t-b+a);
ftn=ftn.*(StepFunction(t,b)-StepFunction(t,-a+b));
ft=ftp+ftn;
return
```

Its execution is again programmed as a function

```
% function TriangleImpulsPlot(a,b,A)

% a= half width of impuls [sec]
% b= centre of impuls [sec]
% A= amplitude of impuls [V]

function TriangleImpulsPlot(a,b,A)

P=100;                  % time interval [sec]
N=512;                  % number of samples [-]
t=linspace(-P/2,P/2,N); % discrete time axis
```

```
name=('Triangle impuls');
ft=A*TriangleImpuls(t,a,b);
plot(t,ft)
axis([-P/2 P/2 -0.2*A 1.2*A])
title([name,'  a='num2str(a),'  b=',num2str(b),'  A=',num2str(A)]);
xlabel('t [sec]');
ylabel('f(t) [V]');
return
```

and after the execution of the TriangleImpulsPlot(10,0,1), the result is shown in the following figure. Run the function with different parameters and observe the resulting figure.



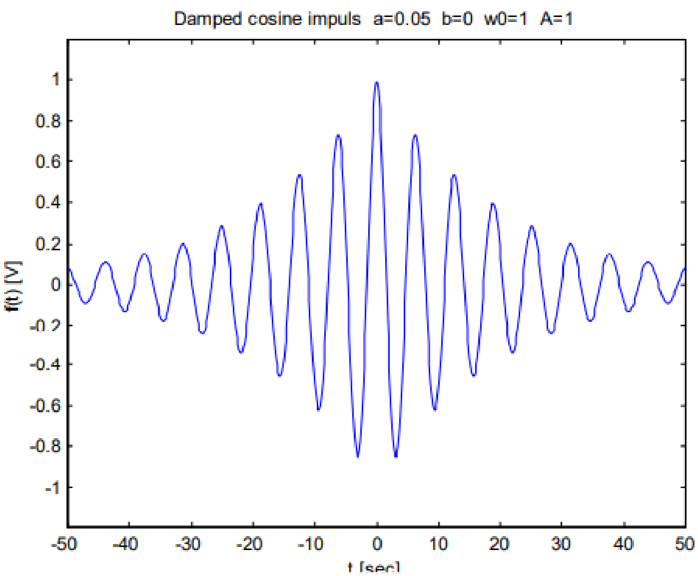
We create one more signal, the damped cosine signal, as a function DampedCosineImpuls.m. The code will be:

```
% function DampedCosineImpuls(t,a,b,w0)
% t= time axis [sec]
% a= damping parameter [1/sec]
% b= centre of impuls [sec]
% w0= cosine frequency [rad/sec]

function [ft] = DampedCosineImpuls(t,a,b,w0);
P=max(t)-min(t);
if abs(b)>P/2              % limit of impuls centre
   b=sign(b)*P/2;

end;

ft=cos(w0*(t+b)).*exp(-a*abs(t+b));
return;
```

The execution of this function is again programmed as the DampedCosineImpulsPlot.m function.

```
% function DumpedCosineImpulsPlot(a,b,w0,A);
% a= damping parameter [1/sec]
% b= centre of impuls [sec]
% w0= frequency of cosine [rad/sec]
% A= amplitude of impuls [V]

function DumpedCosineImpulsPlot(a,b,w0,A);

P=100;                    % time interval [sec]
N=512;                    % number of samples [-]
t=linspace(-P/2,P/2,N);   % discrete time axis

name=('Damped cosine impuls');
ft=A*DampedCosineImpuls(t,a,b,w0);
plot(t,ft)
axis([-P/2 P/2 -1.2*A 1.2*A])
title([name,'     a='num2str(a),'     b='num2str(b),'     w0=',num2str(w0),'
A=',num2str(A)]);
xlabel('t [sec]');
ylabel('f(t) [V]');
return;
```

The execution of the function DampedCosineImpulsPlot(0.05,0,1,1) generates the following figure.



Experiment with the parameters for execution and observe the result. For example, check that for $\alpha = 0$, an undamped cosine is generated. For $w0 = 0$, an exponential signal is generated, or for $\alpha < 0$, an increasing cosine signal is generated.

3 Analysis

Translation has been an integral part of communication between different cultures and languages. However, translation is not merely a process of transferring words from one language to another; it requires a thorough understanding of the cultural context and linguistic features of both the source and target languages. Especially in translating scientific texts with a technical focus, the translator must have extensive knowledge of the specialized field. This understanding can be achieved by applying linguistic analysis, which is a systematic study of language structure, meaning, and use.

In the context of this thesis, the primary objective is to analyze both the resultant text and the process involved in translating from Czech to English. The study focuses on a translated excerpt from the educational materials titled *Signály a systémy Část 1: Spojité signály*, representing the academic technical genre. This resource, authored by Prof. Ing. Pavel Jura, CSc., and provided by Ing. Miroslav Jirgl Ph.D. is part of a Signals and Systems course offered at the Faculty of Electrical Engineering and Communication at Brno University of Technology.

This thesis aims to explore various methods of linguistic analysis that can be employed to analyze translations and demonstrate their efficacy in verifying the accuracy of translations. The significance of linguistic analysis in the translation process will be highlighted through this investigation, and the accuracy and effectiveness of the translation will be demonstrated.

According to Krhutová (2009), linguistic analysis involves various analytical methods that can be used to examine different aspects of language. These methods include syntactic, semantic, discourse, and pragmatic analysis. Syntactic analysis involves the study of the structure and arrangement of words and phrases in a sentence. Semantic analysis focuses on the meaning of words and how they are used in a particular context. Discourse analysis investigates the use of language in different contexts to accomplish certain communication purposes and includes both the addresser's intent and the addressee's interpretation.

Linguistic analysis is a crucial tool in the study of translation, particularly when analyzing translations from Czech to English. These two languages differ significantly in grammar, vocabulary, and syntax. Therefore, a comprehensive analysis of the linguistic features of Czech and English is essential for understanding the nuances of the two languages and how they can be translated effectively.

Using these different types of linguistic analyses, translators can gain a better understanding of the language and culture of both the source and target languages. This knowledge can help translators do more accurate and effective translations by considering the differences between the two languages and the cultural context in which they are used.

3.1 Translation process:

The process of translation had to ensure the preservation of the text's pedagogical effectiveness. The accurate translation of technical terminologies and concepts was of utmost importance. This required either existing knowledge of the terms or the need to find them in other sources, the latter of which posed the greatest challenge. While experience with signals and systems gained from the course helped, there were topics we had not discussed. For these, it was crucial to locate relevant source material with explanations to determine if a specific word was suitable for a particular term.

The most difficult part of the translation was section 2.1.1, which contained several specific signals that required non-literal translation. For instance, *jednotkový skok* could not be translated as *unit jump*, but as *unit step*—a term that was relatively easy to handle due to prior knowledge acquired at the university, translating it accurately without that knowledge would have been more difficult. This is because *unit step* translates back to *jednotkový krok* in Czech, which could cause uncertainty and confusion for a person lacking background knowledge. Terms such as *Diracův impuls* were easy to find, thanks to the author's name. According to Herman (2023), this term is referred to as the *Dirac Delta function* in English, which significantly differs from the Czech equivalent.

Some terms, like *Lineárně rostoucí signál*, required a precise definition. If not for the definition, finding the English equivalent, which Saini (2021) identifies as *Unit ramp signal*, would have been more challenging. In this instance, the literal translation *linearly increasing signal* was maintained in brackets to facilitate understanding. The Czech term *jednotková*, referring to the area of an impulse, translates to *unity* in English, as per Grami (2016), which may sound unusual to a Czech speaker.

In cases where Czech synonyms like *kmitočet* and *frekvence* both translate to *frequency* in English, it's crucial to ensure clarity and correctness. As demonstrated in this section, a translator must either have background knowledge of the topic discussed or access to well-structured material with explanations, examples, and figures. Even with the plethora of sources available today, finding specialized terms can still be challenging. Online dictionaries like the Cambridge Dictionary, Linguee, or TR-EX can be extremely beneficial in defining terms and assisting in choosing the appropriate word for translation. However, to ensure 100% accuracy, it may be necessary to consult a professional in the field.

3.2 Genre theory

Swales's (1990) exploration of genre in the realm of linguistics offers valuable insights that can be applied in the analysis of translated technical documents, such as those in the field of electrical engineering. Swales notes that the term 'genre' has not been a primary focus in linguistics, perhaps due to its roots in literary studies, but is nonetheless critical in understanding different types of communicative events.

Swales underscores the distinction between 'genre' and 'speech events,' demonstrating that the purpose and context of a message play a significant role in its delivery. This differentiation is especially relevant when examining translated technical documents, as the goal and context of the translated text should reflect those of the original.

Saville-Troike (1982) highlights the importance of identifying and understanding the types of communicative events within a specific community such as electrical engineers.

Swales further elaborates on the relationship between 'genre' and 'register' within systemic linguistics. The register pertains to the functional variation in language linked to particular situations, while genre, a more recent concept in linguistics, governs the overall structure of discourse (Swales 1990: 38-42).

3.3 Grammatical level (morphological and syntactic) analysis

When analyzing a translation from Czech to English, a thorough assessment of the grammatical level is necessary, which involves evaluating both the morphological and syntactic features of the text. First, one needs to examine the regularity of the grammatical categories of the word classes used in the text and whether any forms are frequently used. Additionally, the complexity and contribution of phrases to the overall meaning of the text should be assessed. This requires the identification of the sentence types used, as well as commenting on the complexity of the sentences. Moreover, it is important to analyze whether any emphatic structures are present in the text, such as a higher proportion of passive or active voice structures, and to determine their role in conveying the intended meaning effectively. Lastly, the grammatical markers of formality should be evaluated to gain insight into the overall tone and style of the text. By scrutinizing these grammatical features, a deeper understanding of the translation and its efficacy in expressing the intended meaning of the source text can be attained.

Grammatical level in the text:

3.3.1 Identification of word classes:

- Identification of the word classes used, and the frequency of their appearance found, including nouns, verbs, adjectives, adverbs, pronouns, prepositions, and conjunctions, as well as analysis of lexical density.

In this section, let us analyze the word classes and lexical density. Lexical density analysis is significant as it offers insights into the complexity and information richness of a text. A higher lexical density indicates a more significant proportion of content words, such as nouns, verbs, adjectives, and adverbs, compared to function words like prepositions, pronouns, and conjunctions. Generally, academic and technical texts exhibit higher lexical density than casual or conversational texts, resulting in a more information-dense and formal tone (Halliday 1985).

Word classes	Percentage
Nouns	36.33%
Adjectives	7.77%
Verbs	8.86%
Adverbs	2.85%
Prepositions	11.68%
Pronouns	2.5%
Auxiliary Verbs	4.84%

Table 1: Word classes (Retrieved from: analyzemywriting.com (2023a))

In the analysis of the teaching materials for the Signals and Systems course, word classes, also known as parts of speech, were found to have the following distribution as highlighted in Table 1. According to Frydrychová Klímová (2013), the scientific prose style is highly nominal in its character, which corresponds with the results that nouns constituted the majority, accounting for 36.33% of the total, reflecting a significant amount of technical terminology and concepts present in the text. Adjectives and verbs followed, with 7.77% and 8.86%, highlighting the descriptive and action-oriented nature of the content. Adverbs were among the least frequent, representing only 2.85% of the word classes, while prepositions accounted for 11.68%, which is typical for scientific prose style, where prepositions should be among the most frequent word classes (Frydrychová Klímová 2013). Pronouns and auxiliary verbs were relatively low in frequency, with 2.5% and 4.84%, suggesting a focus on explicitness and clarity in the presentation of information. The distribution of word classes in the text supports the notion that the teaching materials are information-dense and maintain a formal, academic tone, proving that the translation closely follows the structure of the source material.

The Analyze My Writing (2023a) website revealed that the translated teaching materials have a lexical density of 55.81%, which is not surprising as such texts contain a significant amount of information-bearing and lexical words, ending up with increased amount of lexical density (Analyze My Writing 2023b). This high lexical density indicates the technical nature of the subject matter, as it requires precise terminology and a clear presentation of concepts to ensure clarity and comprehension. The lexical density of the translation of the chosen teaching materials, which, according to the website, falls into the expository writing category with a score between 55 and 58%, demonstrates that it has successfully preserved the complexity and information richness of the source material. This ensures that the intended audience can effectively engage with the content and grasp the essential concepts.

Examples of sentences with high lexical density (underlining shows the lexical words):

> *Unit ramp signal (linearly increasing signal) is another basic signal.* – Lexical density is 80%

> *In the following tasks, create the desired signals using the previous signal operations.* – Lexical density is 69.23%

> *Systems occurring in this block-diagram process these continuous signals and are consequently called continuous-time systems or simply continuous systems.* - Lexical density is 68.42%.

> *Often systems (both continuous and discrete) are used to control multiple physical devices or systems.* – Lexical density is 66,66%

> *Continuous signals are often converted into a discrete form using so-called sampling, i.e., from the continuous signal, the samples are taken at regular intervals T (switch in Fig. 2-2 switches at regular time intervals for a short moment).* - Lexical density is 63.89%.

3.3.2 Specific nouns, verbs, or adjectives that are used more frequently than others.

Specific nouns, verbs, and adjectives appear more frequently in the translated teaching materials, emphasizing the key concepts and actions within the subject matter. The list of the most common nouns includes *signal*, *function*, *signals*, *time*, *value*, *step*, and *period*, which highlight the primary focus of the course on signal processing and the various characteristics of signals. Among the prevalent verbs are: *is*, *be*, *will*, *can*, which can be attributed to their frequent use as auxiliaries in forming other verb forms. Additionally, the verb *create* has a frequent appearance in the materials, reflecting the text's emphasis on explaining and describing the relationships and behaviors of signals and functions. Adjectives such as *continuous*, *real*, *exponential*, and *discrete* further illustrate the nature of the content and its focus on conveying specific attributes and qualities of signals and systems, making it easier to specify their types. The prevalence of these terms demonstrates the text's focus on the specific technical aspects of the Signals and Systems course while emphasizing the importance of clear and precise language to convey complex ideas. These frequently used terms contribute significantly to the overall meaning and understanding of the subject matter, providing essential context for the reader, and ensuring that the technical concepts are presented in a comprehensive and accessible manner.

3.3.3 Regularly used sentence types.

Interrogative	Declarative	Imperative	Exclamatory
Asks a question	Tells a statement	Gives a command	Shows excitement

Table 2: Types of sentences (Retrieved from: https://grammarbrain.com/declarative-sentences/)

The text primarily utilizes declarative sentences, which aligns with its purpose as educational material. As Dalia (2022) explains in an article on the GrammarBrain website, declarative sentences are used to assert facts, statements, thoughts, opinions, or explanations. In this context, the facts and explanations are particularly significant, given that the excerpt is intended as a teaching resource for students in a signals and systems course.

Another sentence type found in the text is the interrogative sentence. As outlined by Nordquist (2020b), these are sentences that pose a question, and they typically conclude with a question mark. They play a vital role in engaging students, as they stimulate thought and invite participation. By asking questions about the signals and prompting students to solve example calculations, this type of sentence helps enhance the learning process.

Examples of interrogative sentences found in the excerpt:

Which time instant can be considered infinite if τ *= 100,1, 0.01 seconds?*

What is the relationship between these two signals?

Is the function $\cos\omega_0 t$ *an even or an odd function?*

What is its fundamental period?

3.3.4 Examination of markers of formality and the appearance of passive or active voice structures.

3.3.4.1 Formality

In the examination of the translated text's formality, several key aspects contributing to its highly formal tone were found, making it an appropriate and valuable component of this analysis.

Firstly, the text contains specialized terminology related to the field of signals and systems. Terms such as *discrete-time signals*, *continuous-time systems*, *operational amplifier*, and *Laplace and Fourier transforms* demonstrate the author's expertise and establish the text as a credible source of information. This specialized vocabulary, acting as inanimate subjects in sentences, contributes to the impersonality and formality of the text, which as mentioned in Lems's article written in 2018, is typical for CALP (Cognitive Academic Language Proficiency) language, also referred to as academic language or discipline-specific language, meaning, that the translated teaching material follows its standards. The use of such lexical markers indicates a high level of formality and signals the text's relevance to readers with a background in the subject matter.

Secondly, the sentence structure of the text features many complex and compound sentences with multiple clauses and the use of parenthetical statements. For example, *These signals are defined for all time instants (for a continuous segment on the time axis) and are, therefore, called continuous-time signals or continuous signals for short.* Such sentence structures contribute to the formal tone of the text and demonstrate the author's ability to convey complex ideas and relationships. Formal pronouns such as ***one*** are used to introduce examples or specific cases related to the topic, and the inclusive ***we*** refers to the reader or general people. These are other factors enhancing the formality and professionalism of the text.

Additionally, the text employs abbreviations such as *A/D* (analog-to-digital converter) and *SV* (solenoid valve), commonly used in technical writing to enhance clarity and conciseness. The use of these abbreviations contributes to the formal tone and demonstrates the author's familiarity with the field conventions.

The formality of the text is further established through its consistent use of objective language, precise definitions, and mathematical notation.

Examples:

> **Objective language**: - "The information you find for use in assignments should be factual. Facts are objective, concrete bits of information, usually expressed by precise numbers or quantities, in weights and measures, and in concrete language" (Writing Department 2014: 1).
>
> *The actual room temperature is measured by a thermometer whose signal (temperature reading υ [°C]) is converted into an electrical signal (again by a system consisting of a physical quantity transmitter).*
>
> **Precise definition:** *A discrete system is basically an algorithm working with a sequence of numbers (the sampled values of the signal f(kT) k = 0,1,2,...).*
>
> **Mathematical notations:** $s(t) = A\sin(\omega t + \Theta)$, $f(t) = e^{at}$, $t \in (-\infty, +\infty)$.

By avoiding colloquial expressions or idiomatic phrases, the author and, therefore, the translation maintains the text's scholarly tone and ensures that it remains accessible to readers with varying degrees of familiarity with the subject matter.

Lastly, the text adheres to standard grammar rules in punctuation, consistently using commas, periods, and parentheses. This attention to detail in punctuation further solidifies the text's formality and contributes to its overall readability and coherence.

As a part of this thesis, the translated text's highly formal tone, achieved through the combined use of specialized terminology, complex sentence structures, abbreviations, objective language, mathematical notations, and adherence to grammar rules, serves to support the rigorous and scholarly nature of the translated work.

3.3.4.2 Passive or active voice structures

In the examined teaching material translation, the text predominantly employs active voice, which effectively conveys the subject matter by presenting the material clearly and directly. The active voice allows the writer to present information in a more engaging and authoritative manner, making it easier for the reader to understand. Examples of active voice sentences include: *We encounter the terms 'signal' and 'system' almost daily without realizing it*, and *The student will learn how to mathematically describe continuous and discrete signals and perform various operations on these signals.*

Passive voice structures are used sparingly throughout the text, creating a clear and concise writing style. The minimal use of passive voice is beneficial in this context because it helps maintain clarity and avoids unnecessary complexity. Examples of passive voice sentences include: *Continuous signals are often converted into a discrete form using so-called sampling, i.e., from the continuous signal, samples are taken at regular intervals T,* and *The placement test is designed to be self-evaluated by the student.* The text employs passive voice when describing processes, focusing on the process or outcome rather than the doer of the action.

The study material also employs imperative sentences in the context of exercises and examples, providing clear instructions to the reader. Examples of imperative sentences include: *Plot the same vector for the same but negative frequencies*, and

Create a periodic signal q(t) with period P, duration 2a, and amplitude A, shown in ***Fig. 2-13***. Use of imperative sentences helps guide the reader through the tasks and promotes engagement.

In summary, the text effectively balances the use of active and passive voice structures, contributing to a clear and informative piece of academic writing. Active voice is used predominantly, making the text more engaging and easier to understand, while passive voice is employed selectively to highlight specific processes or outcomes. Using imperative sentences in the context of exercises and examples effectively guides the reader through the tasks, ensuring a well-rounded learning experience.

3.3.5 Grammatical level conclusion

The grammatical analysis of the Czech to English translation of the Signals and Systems course materials illustrates a faithful representation of the source's technical and academic content. The findings underscore the importance of grammatical evaluation in translating specialized content to ensure effective communication and meaningful learning experience.

3.4 Semantic level analysis

The semantic level plays a pivotal role in analyzing translated teaching materials, as it uncovers the deep structure of the text and conveys more profound meaning. It involves the analysis of several elements, such as the explicitness of the text, allusions, symbols, sense relations, and figurative language, to understand the work's themes and messages comprehensively. To analyze the semantic level of a selected teaching material translation, this part of the thesis examines some of the abovementioned elements to uncover their significance.

Experts in the field of translation analysis, such as Hatim and Mason (1997) and Baker (2011), emphasize the importance of analyzing the semantic level of a text to understand its deeper meanings and nuances in the original language and convey them accurately in the target language, which involves a comprehensive analysis of the text to identify appropriate and effective translation strategies, ensuring both adherence to the original and accessibility to the target audience.

Semantic level analysis of the Czech-to-English teaching material translation will be conducted, examining its explicitness, symbols, sense relations, and figurative language. The analysis of the sense relations in the text will offer a framework for understanding the meaning of the work. Finally, the identification of the excerpt's language type will be conducted with the discussion if the figurative language belongs to and appears in technically oriented teaching materials.

This part of the thesis comprehensively analyzes the semantic level of the translation, providing insights into the meaning and significance of used elements. Through this analysis, readers will better understand the content and structure present in the text, as well as the techniques used to convey them.

Semantic level in the text:

3.4.1 Assessment of the explicitness of the text:

- Evaluation of the level of straightforwardness or indirectness in conveying the text's meaning. Identification and comment on symbols and mathematical notation utilized in the text.

3.4.1.1 Explicitness and straightforwardness

The teaching material is highly technical and largely explicit in nature without vagueness, implication, or ambiguity, meaning that it directly states the information it's intended to convey, which is, according to Merriam-Webster dictionary, true to how explicit text should be written (Editors of Merriam-Webster 2021). This is a characteristic of academic and technical writing genre, which is being discussed by Dragos (2022), mentioning clarity, relevance, factual accuracy, and logical structure are highly valued in technical writing. The text covers topics related to signal processing, including continuous signals, operations with signals (e.g., time shifting, flipping, multiplication, addition, and subtraction), and specific types of signals such as the unit step, Dirac delta function, unit ramp signal, sinusoidal signal, and real and complex exponential signals. The technical concepts are explained in a straightforward manner, with mathematical formulas and examples included to illustrate the points being made. Diagrams and figures are included and utilized well, which provides additional visual aids to help readers understand the material. The use of specific terminology and symbols associated with the subject matter adds to the explicitness of the text. There are also sections in the text that discuss how to apply the concepts practically, such as creating signals using the operations mentioned, plotting the signals in MATLAB, and exercises for readers to complete, which proves that the excerpt and its translation are being done well for educational purposes.

3.4.1.2 Symbols and Mathematical Notation

Study of signals and systems in the engineering domain thrives in extensive employment of mathematical symbols, operations, and numerical references. The translated teaching material utilizes a diverse array of standard notation to express intricate concepts that range from continuous signal functions, unit steps, and Dirac delta functions, to sinusoidal and complex exponential signals.

Frequent use of various symbols used to denote different parameters and components appears in the excerpt. For example, t stands for time, while $f(t)$ represents a time-dependent function. Discrete sampling periods are marked by kT, while amplitude, angular frequency, and phase shift in the sinusoidal signal equation are denoted by A or Greek letters ω, and Θ, respectively. Other frequent Greek letters appearing in the text would be α, ε, and δ. They are deployed for specific parameters in equations. For example, they may be found in the unit step equation or the Dirac delta function. Which, according to the StephenWolfram website, corresponds with their research of the most frequently used symbols, as they appear in the Dictionary of Physics and Mathematics Abbreviations (see Fig.1). Additionally, the imaginary unit in complex exponential signals is represented by 'j'.

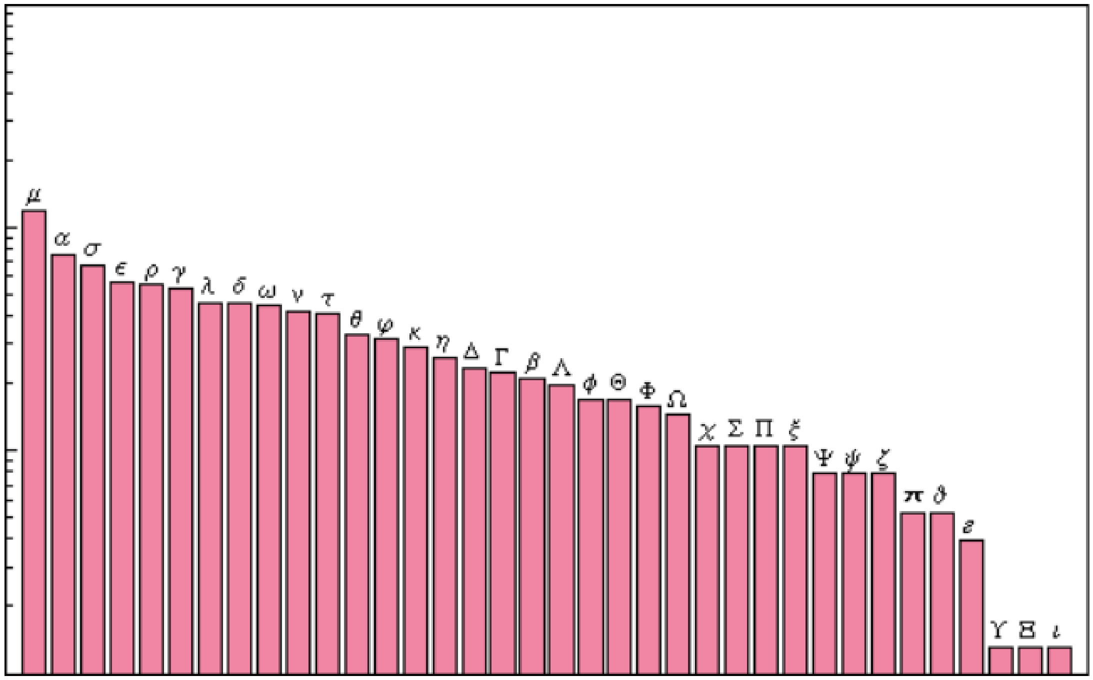


Fig. 1 Frequency distribution of symbols in the Dictionary of Physics and Mathematics Abbreviations. (Retrieved from https://www.stephenwolfram.com/)

The differentiation of signal types is accomplished through the application of letter suffixes, such as *s(t)* for a signal with continuous time and *f(kT)* for sampled values of the signal. Mathematical expressions are also deployed for operations with signals. Below are examples of such operations. Especially noted is signal multiplication, and the concept of signal inversion. This concept is signified by the use of a negative number.

Examples:

$g(t) = f(t)h(t)$

$f(t) = \sigma(t+1)\sigma(-t+1)$

Numerical identifiers are assigned to mathematical expressions, likely corresponding to chapter and equation numbers, to interlink equations with the textual discourse, thereby fostering a more accessible comprehension for the readers. Exercises and tasks are embedded within the text, denoted by the term *Exercise* followed by a number, and an expected outcome or *key* is often provided to guide understanding.

Figure references to the captions of figures, annotated as *Fig. 2-1*, *Fig. 2-2*, etc., supplement the textual and mathematical explanations, presenting graphical interpretations of the signals or systems under discussion. This integration of visual, textual, and mathematical methods of expression facilitates a robust comprehension of the subject matter.

In conclusion, this part of the thesis presents a detailed exploration of the usage of mathematical symbols, operations, and figure references in the field of engineering, specifically in the study of signals and systems.

3.4.2 Analysis of the sense relations:

- Breakdown of the text for meaning-related words and phrases, including antonyms, synonyms, hypernyms, hyponyms, and other lexical cohesive devices. The sense relations will be discussed in detail, and their impact on the text's overall meaning will be evaluated.

The author discusses various concepts and their applications. To analyze the translated excerpt, we will focus on sense relations of key terms as defined by Halliday and Matthiessen (2004). Sense relations are semantic features that link the members of a lexical set, and they include synonymy or antonymy, hypernymy, hyponymy, and meronymy. Understanding these relationships helps to grasp the meaning of the text more effectively.

3.4.2.1 Synonymy or Antonymy:

Synonyms are different words with the same or similar meanings, while antonyms are words with opposite meanings. In the context of signals and systems, some examples of antonyms include *continuous* and *discrete signals* which serve as examples of relational antonyms. These two types of signals have opposing characteristics: continuous signals have an infinite number of values, whereas discrete signals have a finite number of values.

Specific examples of synonyms:

Algorithm and program:

A discrete system is basically an ***algorithm*** *working with a sequence of numbers (the sampled values of the signal f(kT) k = 0,1,2,...). This* ***algorithm*** *is often implemented on some computer or microprocessor, and its resulting values (the output of the discrete system) are again a discrete signal, i.e., a sequence of numbers.*

In this context, the terms 'algorithm' and 'program' may seem like synonyms, as they both refer to a set of instructions for processing discrete signals. Therefore, they can appear interchangeable, but they are not. An algorithm is a sequence of steps or rules used in calculations or other problem-solving operations (Editors of Merriam-Webster 2023a). On the other hand, a program is a sequence of coded instructions, representing a specific implementation of one or more algorithms in a particular programming language, which can incorporate multiple algorithms, data structures, user interfaces, and other elements (Editors of Merriam-Webster 2023b). That is why the term 'algorithm' was chosen.

Temperature reading and temperature measurement:

*The actual room temperature is measured by a thermometer whose signal (****temperature reading*** υ *[°C]) is converted into an electrical signal (again by a system consisting of a physical quantity transmitter).*

Here, *temperature reading,* and *temperature measurement* can be viewed as synonyms since they both refer to determining the room's temperature using a thermometer. Both terms are related and often used interchangeably, but they can be differentiated based on their specific usage in the context. The term *temperature reading* can be more focused on the end-result, or the numerical value provided by the measurement device, while *temperature measurement* could refer to the entire procedure of acquiring that temperature data. Therefore, the term *reading* was chosen over the term *measurement*.

Specific examples of antonyms:

Continuous-time signals and discrete-time signals:

Continuous signals *are often converted into a discrete form using so-called sampling... Such sampled signals are not (unlike continuous signals) defined over a continuous time period but are defined only in a discrete set of sampling instants kT k = 0,1,2,... and are, therefore, called* ***discrete-time signals*** *or* ***discrete signals*** *for short.*

Continuous-time signals are defined over a continuous time period, while discrete-time signals are defined only at discrete time instants. These two terms are relational antonyms since they represent opposite types of signals based on their time representation, and they cannot exist without the other.

Increase and decrease:

If $\alpha > 0$, then the exponential function ***increases*** *from 0 over all limits as t* ***increases*** *from $-\infty$ to $+\infty$ as shown in the left part of* ***Fig. 2-4.*** *If $\alpha < 0$, then the exponential function* ***decreases*** *from $-\infty$ to 0 as t grows from $-\infty$ to $+\infty$, as shown in the right part of* ***Fig. 2-4.***

In this context, *increase* and *decrease* are antonyms as they represent opposite trends in the exponential function's behavior. The terms *increase* and *decrease* are complementary antonyms. Complementary antonyms are pairs of words that describe an opposite spectrum of meanings and are absolute opposites that cannot happen both at the same point or within the same specific interval on the function.

Positive and negative frequency:

Given the fact that $\left|e^{j\omega t}\right| = \sqrt{(cos\ \omega t)^2 + (sin\omega t)^2} = 1$ *the expression* $e^{j\omega t}$ *can be imagined as a unit vector rotating in the complex plane with angular velocity* ω.... *Let us create a vector to this vector (signal) that rotates in the complex plane in the reverse direction (this signal has a* ***negative frequency****) i.e.,*

$e^{-j\omega t} = cos\omega\ t - j\ sin\omega\ t \quad t \in (-\infty, +\infty)$

Positive frequency refers to the angular velocity of a unit vector rotating in the complex plane in one direction, while ***negative frequency*** refers to the angular velocity of a unit vector rotating in the opposite direction. These terms are complementary antonyms because they represent opposite directions of rotation in the complex plane, and a single unit vector cannot rotate in both directions simultaneously.

3.4.2.2 Hypernymy or Hyponymy:

Hypernyms are words that represent general categories, encompassing more specific words known as hyponyms. In this relationship, hyponyms belong to a group of words that are subordinate to their respective hypernyms. In the context of signals and systems, the term *signal* acts as a hypernym, including the hyponyms *continuous signal* and *discrete signal*. These hyponyms represent specific instances or subcategories of the term *signal*, illustrating the linguistic relationship between hypernymy and hyponymy in the discussed topic.

Specific examples appearing in the translated excerpt:

Hypernyms and Hyponyms:

Hypernym: *Signals*

Hyponyms: *Continuous signals, Discrete signals*

Hypernym: *Systems*

Hyponyms: *Continuous systems, Discrete systems*

Hypernym: *Basic continuous signals*

Hyponyms: *Unit step, Dirac delta function, Unit ramp signal, Sinusoidal signal, Real exponential function, Complex exponential function*

Hypernym: *Operations*

Hyponyms: *Sampling, Algorithm*

Hypernym: *Physical devices*

Hyponyms: *Microphone, Loudspeaker, Thermometer, Solenoid valve*

Hypernym: *Mathematical tools*

Hyponyms: *Functions, Fourier transforms, Laplace transforms, Matrix calculus*

3.4.2.3 Meronymy and Holonymy:

Meronyms are words representing parts of a whole, while the whole is referred to as the holonym. In the context of signals and systems, components within continuous and discrete signals can be considered meronyms, while the entire signals themselves act as holonyms. For instance, in a continuous signal, individual waveform segments and time instants are meronyms, while the entire continuous signal is the holonym. In a discrete signal, discrete samples or sequences of numbers are meronyms, and the whole discrete signal is the holonym. These relationships help to understand the structure and components of signals and systems.

Specific examples:

In the *phone call* example, the *acoustic signal* and *electrical signal* can be considered **holonyms**, while the *time instants* or *waveform segments* within the acoustic signal, and the *electrical signal waveform*, can be considered **meronyms**.

In the *programmable temperature control* example, the entire *temperature control system* is a **holonym**, while its components such as the *thermometer*, *analog-to-digital converter*, and *solenoid valve* can be considered **meronyms**.

In the *basic continuous signals section*, the *unit step, Dirac delta*, *unit ramp signal*, and *sinusoidal signal* are **holonyms**, while the individual *time instants* or *values of these signals* are **meronyms**.

In conclusion, the analysis of sense relations in the translated teaching materials excerpt provides an insight into the semantic unity of the text. By examining and identifying all the chosen sense relations we can effectively grasp the relationships between key terms and their applications. This type of analysis is important for a thesis as it ensures that the translated materials convey accurate and precise information to the readers. By maintaining the intended meaning and relationships between terms, we enable students to develop a thorough understanding of the subject matter, regardless of their level of expertise.

3.4.3 Identification of the text's language type.

First, it would be beneficial to understand the difference between literal and figurative language, and from that, discuss whether the use of figurative language is appropriate in academic texts such as teaching resources. Forstall (2023) describes literal language as a form of communication that does not employ figures of speech. Instead, it uses words or phrases in their exact, straightforward sense, which we have already explored in previous chapters. This type of language is precise and direct, and readers can easily grasp the intended meaning without the need for interpretation. Literal language is ideally used when the goal is to provide explicit, unambiguous explanations.

On the other hand, figurative language employs various rhetorical devices to enhance the impact or persuasive power of the text. The use of figures of speech, such as metaphors, similes, and oxymorons, can add depth and nuance to the message. However, it may also increase the complexity of the text, making it potentially challenging for those unaccustomed to these linguistic devices. Figurative language is frequently found in poetry or narrative fiction, where it contributes to the creative richness of the prose (Forstall 2023).

The choice between literal and figurative language depends on the specific context and purpose of the text. For teaching materials, precision and explicitness are generally more beneficial, facilitating easier understanding for students. Therefore, literal language is typically the more appropriate choice. This preference is also reflected in the translated excerpt, which does not employ figurative language regularly, as other types of text would. There are, however, highly conventionalized metaphors, e.g., waveform. Due to their standardized use and meaning they are usually not perceived as instances of figurative meaning.

3.4.4 Semantic level conclusion

The semantic analysis provides insights into the text's structure, emphasizing the role of sense relations, explicitness, and symbolic language. This examination shows the complexity of conveying academic concepts and confirms that the translation follows the integrity of the original content for effective student learning.

3.5 Discourse / textual level analysis

A translated teaching material's discourse/textual level is an essential aspect of translation analysis, requiring the examination of how the text is structured and how various language elements are employed to promote coherence and cohesion. This level involves the analysis of the cohesive devices, text structure, discourse markers, and other features contributing to the text's overall coherence. Furthermore, it is essential to analyze the text's intertextuality features to better understand its characteristics.

To analyze the discourse/textual level of the translated teaching materials, this part of the thesis will begin by defining the concept of discourse and textual analysis and discussing its importance in translation studies. The cohesive devices used in the text will be analyzed to evaluate how typical they are of the studied language variety. Halliday and Matthiessen (2004) suggest that grammar is structured hierarchically, with different ranks of units. One such rank is the clause, which comprises phrases or word groups. Within these groups, words serve as constituents, and morphemes (the smallest meaningful units) make up words. Examples of morphemes found in the translation include *follow + ing*, and *shift + ed*. These units appear as strings in written text, and the relationships between these strings and their meanings contribute to the formation of discourse.

The structure of the text, which includes the presence or absence of a title, sequencers, discourse markers and other devices used to promote the text's coherence, will be discussed. Through this analysis, this part of the thesis will provide an evaluation of the discourse/textual level of the translated teaching materials, offering insights into their deeper meanings and the significance of chosen wording.

Discourse / textual level in the text:

3.5.1 Cohesive devices:

- Examination of the use of cohesive devices in the text and determination of how typical they are for the studied language variety.

3.5.1.1 Cohesive Devices

Cohesive devices, sometimes called discourse markers, linkers, linking words or cohesive relations, are essential elements in text that signal the relationship between different parts of the text. They include conjunction, reference, substitution, ellipsis, and lexical cohesion (Halliday & Hasan 1976).

Instances of used cohesive devices in the translated excerpt:

Reference:

The text uses both anaphoric and cataphoric reference. Anaphoric reference is when a word or phrase refers back to other ideas in the text for its meaning (e.g., *this value*, *such an amplifier*, *it*, *this property,* refer back to previously mentioned concepts) (StudySmarter n.d. a). Cataphoric reference is when a word or phrase refers forward to something later in the text (e.g., *the following chapter*, *the following tasks*) (StudySmarter n.d. b). Repeated use of terms like *signal*, *system*, *continuous-time*, *discrete-time*, *algorithm,* etc., throughout the text, helps to maintain the continuity and the reader easily identifies which topic is being discussed.

Conjunction:

The text uses linking devices to join clauses or sentences. Examples include *for example*, *however*, *therefore*, *conversely*, and *then*. These words provide a logical connection between ideas, making the text more coherent.

The execution of the Dirac delta is not possible. ***However****, we can implement signal S.*

If T > 0, then f (- t - T) shifts the signal f (-t) to the left by T seconds since f (- t - T) = f [-(t + T)] see Fig. 2-7 in the middle. ***Conversely****, f (-t+T) shifts the signal f (-t) to the right by T seconds since f (- t + T) = f [-(t - T)] see Fig. 2-7 on the right.*

Lexical Cohesion:

This occurs when the meaning of a word or a phrase depends on the understanding of another word or phrase in the text. The text uses related technical terms like *signal*, *time*, *amplitude*, *function*, etc., which are all semantically related and contribute to the overall theme of the excerpt.

3.5.1.2 Typicality of Cohesive Devices for the Studied Language Variety

The excerpt is a typical example of academic writing in the field of engineering, specifically signals and systems. The cohesive devices used in the text are common in academic technical genres. The use of referencing (both anaphoric and cataphoric) is quite standard in academic texts to ensure that the reader can follow the argument being made. Similarly, the use of conjunction to logically connect ideas is a typical feature of academic writing. Lastly, the use of lexical cohesion, especially technical terms, is very characteristic of academic texts in the engineering field.

Overall, the use of cohesive devices in the text enhances its coherence, making it easier for the reader to understand the relationships between different parts of the text and the overall argument, which, given the nature of the subject matter and the need for clarity of teaching resources, is crucial. Thus, well-implemented cohesive devices not only aid in creating a more fluid and accessible read, but they also foster improved comprehension and retention of complex information. This is especially important in the context of educational materials, where the goal is to facilitate learning and understanding.

3.5.2 Text structure:

- Analysis of the structure of the translated materials compared to the original text, including the presence or absence of titles, sequencers, discourse markers, linking devices, and other devices used to promote coherence.

The primary objective was to preserve the structure, given that the source material is an educational resource. Hence, all titles, references, and other elements that contribute to the structure were translated and retained in their original positions. As a result, no title, figure reference, or equation numbering was excluded.

Instances of specific aspects appearance in the translated excerpt:

Titles:

The translated text includes titles and subtitles *2 Continuous signals and their analysis* which is the exact translation of the original Czech title *2 Spojité signály a jejich analýza*. Subtitles are also present, one of them being *2.1 Basic continuous signals and their properties* which is the translation of the original: *2.1 Základní spojité signály a jejich vlastnosti* being subordinate to the first example. This maintains the structure of the text and indicates the start of a new section or focus of discussion.

Sequencers:

Frame markers		
Sequencers	Introduce a new sequence	
-Spatial	-Relative to space	*On the one hand . . . on the other hand*
-Temporal	-Relative to time	*First . . . then . . . finally*
-Numerical	-Relative to enumeration	*Firstly . . . secondly . . . .*
Topicalisers	Introduce a new subject	*Concerning X . . .*
Illocution markers	Indicate the author's illocutionary act	*Before doing X, let us do Y, I will now come to . . .*
Reviews/previews	Anticipate or repeat a stage in the text	*In section 3, . . .* *In this chapter, I have . . .*

Table 3: Proposal for a categorization of frame markers. (Hempel, S., & Degand, L. (2008), Retrieved from https://www.researchgate.net/)

Hempel and Degand's (2008) study references the works of Charolles, Fauconnier, and Jackiewicz and Minel, among others. In explaining discourse-organizing elements, they use Charolles' concept of discourse frames. Similar to Fauconnier's 'mental spaces' (Fauconnier 1994), these frames can be defined as textual sections that encompass one or more propositions, all adhering to the same interpretation criterion (Charolles 1997:25). The principles guiding these mental structures could be spatial, temporal, thematic, goal-oriented, among others. Discourse frames assist in breaking down the information into homogeneous sections and in establishing textual cohesion, as highlighted by Jackiewicz and Minel (2003:2). Sequencers, according to their study, are the linguistic elements that launch new sequences in a text. These can be categorized into spatial sequencers (pertaining to space), temporal sequencers (relating to time), and numerical sequencers (concerned with enumeration), (see Table 3).

Spatial Sequencers: According to Hempel and Degand (2008) spatial sequencers cover linguistic features that are relative to space. In the translated excerpt, explicit spatial sequencers like *on the one hand* are not present. However, phrases like *in the left part of Fig. 2-1*, *in the right part of the figure*, *in computer memory or on CDs*, *in a room*, *in the figure* give a sense of spatial arrangement.

Temporal Sequencers: These are used to order events in time or as stated in Hempel and Degand's work introduce temporal sequence. Examples from the translated excerpt include *almost daily*, *when we make a phone call*, *then*, *again*, *often*, *at regular intervals T*, *at time instants kT k = 0,1,2,...*, *at the same time instants*, *during the day*, and *in the following chapter*.

Numerical Sequencers: These are used to list or rank items in numerical order. The series *kT k = 0,1,2,...* or the mentioned courses *Electrical Engineering 1* and *Electrical Engineering 2, Mathematics 1, Mathematics 2, and Mathematics 3* are an example of a numerical sequencing.

Discourse Markers:

As per StudySmarter, discourse markers refer to certain words and phrases utilized to regulate and structure a conversation or discourse. They serve as a bridge linking sentences without altering the overarching meaning of the discourse. Often referred to as sentence connectors, linking words, or linking phrases, they include terms like *well*, *I mean*, *because*, and *however*. Nordquist (2020c) then mentions that discourse markers typically exist independently from the syntax of the sentence meaning, that if you were to remove a discourse marker, the sentence would still maintain its structural coherence.

Examples include: *For example*, *then*, *This*, *These*, *Such*, *One such example*, etc.

For example*, a time interval of* 10^{100} *seconds (that is approximately* $3\cdot10^{92}$ *years) is certainly much smaller than a mathematical infinity.*

Furthermore*, the desired value (obtained for a given time instant kT k = 0,1,2,...from the desired temperature time course) enters the algorithm at the same time instants.*

*...**but** without this, it would be impossible to implement the tasks in MATLAB.*

So*, if the signal is periodic with a period P, then it is also periodic with periods 2P, 3P...*

It is filtering ***because*** *the Dirac function* $\delta(t - \tau)$ *filters out only the value at point* $t = \tau$ *from all values of the function* $f(t)$*.*

Discourse markers serve as instrumental devices in enhancing the logic and cohesiveness of speech and writing. Absent these markers, the links between sentences and paragraphs may lack fluidity and clarity (StudySmarter n.d. c).

Other devices used to promote coherence:

The translation and the source document also use repetition of key terms (*signal*, *system*, and others) to maintain coherence and ensure the reader can follow the thread of the text. Parentheses are used to provide additional information or clarification, as in the original text, which also helps the reader understand the topic better.

3.5.3 Intertextuality:

- Identification of any intertextuality features in the text.

Intertextuality refers to the relationship between one text and another, whether directly or indirectly, through the means of allusions, references, or borrowing concepts, themes, or ideas. This can involve the use of quotations, paraphrasing, or the incorporation of specific content that connects to other works.

Vukadin (2019) cites Fiske's work from 1987, in which he introduces the concept of horizontal intertextuality. This term is used to describe the relationships between works that share similar content or genre and are conveyed through the same medium or mode. This is contrasted with vertical intertextuality, which refers to the connections between related works that are expressed across different forms of media or mode. Even in today's digital age, when individuals might document their observations or thoughts across diverse online platforms, sourcing accurate and relevant information can prove more challenging than referencing books that delve into the topic.

In the translated excerpt, the text primarily serves as an educational resource, explaining various concepts related to signals and systems, and their respective properties and applications. The aim is to provide students with a solid understanding of these concepts, allowing them to apply this knowledge in various contexts, both academic and practical.

Regarding the identification of intertextuality, the excerpt does not explicitly reference or borrow from other texts in a literary sense, as would be common in novels, essays, or works of criticism. However, within the academic field, intertextuality often refers to the use of prior research, theories, or conceptual frameworks to build upon or contrast with new insights (Rojano et al. 2014). In this case, the intertextual elements can be identified in the form of theoretical concepts and mathematical formulas that have been established by previous scholars or researchers in the field.

For instance, the text introduces concepts such as unit step, Dirac delta function, unit ramp signal, sinusoidal signal, and real and complex exponential function. Each of these concepts has been developed and described in various academic resources and texts in the field of signals and systems. Therefore, the teaching material implicitly references these foundational texts and builds upon these established theories and models.

Another aspect of intertextuality in this text is its reliance on the symbolic language of mathematics. The equations and symbols used here form a "text" of their own, one that is universally recognized and understood by those within the scientific community.

$$cos\omega\, t = \frac{e^{j\omega t} + e^{-j\omega t}}{2} \qquad sin\omega\, t = \frac{e^{j\omega t} - e^{-j\omega t}}{2j} \qquad (2.20)$$

$$e^{j\omega t} = \cos\omega\, \mathrm{t} + j\, \sin\omega\, t \quad t \in (-\infty, +\infty) \qquad (2.17)$$

This mathematical language is used to express complex ideas succinctly and precisely, and it forms a crucial part of the overall meaning of the text.

Additionally, it's important to note that the exercise problems refer to the concepts and ideas discussed earlier. This type of internal intertextuality is crucial in teaching materials, helping students to link new knowledge with what they have already learned.

Moreover, the text also references specific individuals, such as P.A.M. Dirac, the English theoretical physicist after whom the Dirac delta function is named, and the Swiss mathematician Euler, whose formula is used to describe the complex exponential function.

> *Another basic signal is the so-called **Dirac delta function** or simply **Dirac delta** $\delta(t)$ (P.A.M. Dirac, 1902- 1984, English theoretical physicist).*

> *The so-called **Euler's formula** (after the Swiss mathematician Euler, 1707-1783) ...*

These references again point to an intertextual connection, as these individuals have made significant contributions to the field, and their work forms an essential part of the theoretical framework upon which the teaching material is based.

Finally, this text also anticipates future discourse. For instance, the MATLAB exercises section makes a reference to the future chapters, creating an intertextual link that projects forward.

> *This relationship is called the filtering property of the Dirac function. It is filtering because the Dirac function $\delta(t-\tau)$ filters out only the value at point $t=\tau$ from all values of the function $f(t)$. **We will** be using this property often in the **future**.*

> ***We will** use this signal frequently in the* ***future**. Therefore, we will create it as a MATLAB function with the addition of a time offset of α seconds.*

This kind of intertextuality is common in educational materials where later chapters build upon earlier ones.

In conclusion, the intertextuality in the translated material as an academic text mainly arises from its embedding in the scientific discourse of signals and systems and the use of mathematical language. The text also uses internal references and anticipates future discourse to help structure students' learning. It thus demonstrates the interconnectedness of academic texts and the importance of prior work in shaping and informing new teaching and learning resources.

3.5.4 Discourse / textual level conclusion

In conclusion, the discourse/textual-level analysis of the translated teaching materials showed a thorough employment of cohesive devices, clear text structure, and intertextual connections. This enhanced overall coherence and promoted effective learning. The study emphasized the role of discourse markers, sequencing, referencing, and the symbolic language of mathematics in facilitating understanding. It thereby underscored the significance of discourse/textual-level analysis in the translation of educational content.

4 Conclusion

The significance of English in the contemporary world, particularly within the scientific domain, is undeniable. English not only serves as a universal mode of communication but also influences other languages, as seen in the borrowing of English terms into Czech. The task of translating scientific texts demands a deep understanding of the information, a comprehensive study of the problem, and extensive research to ensure precise translation from one language to another. This task becomes more intricate when dealing with specialized terminology. A translator, therefore, must possess a firm grasp on the functionality of the described elements for the translation to be accurate.

The bachelor thesis, in its subsequent parts, delves deeper into the specifics of translation with a detailed analysis of grammatical, semantic, and discourse features. The analysis of Signals and Systems teaching materials showed a high degree of accuracy and fidelity to the original content at a grammatical level, demonstrating the importance of a thorough grammatical assessment to effectively communicate the complexities of specialized content.

The semantic analysis highlighted the role of explicitness, symbols, sense relations, and literal language in conveying the meaning of the text. It showed the necessity of semantic examination for a deeper comprehension of the academic content and the translation process's efficacy.

The analysis of the discourse/textual level brought forth the depth and complexity of the translated teaching materials. Effective use of cohesive devices, preservation of text structure, and intertextuality were seen as crucial in ensuring coherence and comprehension. This level of consideration in the translation suggests that the translated materials can serve as effective, accessible educational resources for engineering students.

In conclusion, translation of scientific materials is a complex process requiring an understanding of the topic, knowledge of specialized terminologies, and careful analysis of grammatical, semantic, and discourse levels. The findings of this thesis reinforce the value of such an approach, making it indispensable for accurate and effective translation in the scientific field.

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6 Appendix