



VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
BRNO UNIVERSITY OF TECHNOLOGY



FAKULTA ELEKTROTECHNIKY A KOMUNIKAČNÍCH
TECHNOLOGIÍ
ÚSTAV JAZYKŮ

FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION
DEPARTMENT OF FOREIGN LANGUAGES

KOMENTOVANÝ PŘEKLAD ODBORNÉHO TEXTU
COMMENTED TRANSLATION OF TECHNICAL TEXT

BAKALÁŘSKÁ PRÁCE
BACHELOR'S THESIS

AUTOR PRÁCE
AUTHOR

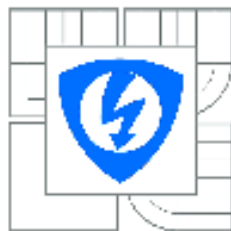
DANIELA MIČKOVÁ

VEDOUCÍ PRÁCE
SUPERVISOR

Mgr. PETRA LANGEROVÁ

ODBORNÝ KONZULTANT
CONSULTANT

prof. Dr. Ing. ZBYNĚK RAIDA



VYSOKÉ UČENÍ
TECHNICKÉ V BRNĚ

Fakulta elektrotechniky
a komunikačních technologií

Ústav jazyků

Bakalářská práce

bakalářský studijní obor
Angličtina v elektrotechnice a informatice

Studentka: Daniela Mičková

ID: 159168

Ročník: 3

Akademický rok: 2014/2015

NÁZEV TÉMATU:

Komentovaný překlad odborného textu

POKYNY PRO VYPRACOVÁNÍ:

1. Úvod
2. Teoretická část
3. Překlad
4. Komentář k překladu
5. Závěr

DOPORUČENÁ LITERATURA:

Krhutová, M. Parameters of Professional Discourse. Brno: Tribun EU, 2009

Knittlová, D. a kol. Překlad a překládání. Olomouc: Univerzita Palackého v Olomouci, Filosofická fakulta, 2010

Termín zadání: 9.2.2015

Termín odevzdání: 22.5.2015

Vedoucí práce: Mgr. Petra Langerová

Konzultanti bakalářské práce: prof. Dr. Ing. Zbyněk Raida

doc. PhDr. Milena Krhutová, Ph.D.
Předseda oborové rady

UPOZORNĚNÍ:

Autor bakalářské práce nesmí při vytváření bakalářské práce porušit autorská práva třetích osob, zejména nesmí zasahovat nedovoleným způsobem do cizích autorských práv osobnostních a musí si být plně vědom následků porušení ustanovení § 11 a následujících autorského zákona č. 121/2000 Sb., včetně možných trestněprávních důsledků vyplývajících z ustanovení části druhé, hlavy VI. díl 4 Trestního zákoníku č.40/2009 Sb.

ANOTACE

Tato bakalářská práce se zaměřuje na překlad učebního textu z oblasti elektrotechniky. Práce má za cíl přeložit a analyzovat odborný učební text a je rozdělena na tři hlavní části. V teoretické části je uvedena zejména charakteristika odborného a učebního stylu, typy překladatelských postupů, překladatelské transformace a funkční perspektiva větná. Praktická část předkládá anglický překlad úryvku ze skript a analytická část má za cíl analyzovat problémy, které se vyskytly při překladu a zhodnotit charakteristické znaky odborného učebního stylu založené na analýze tohoto překladu.

KLÍČOVÁ SLOVA

odborný styl, učební styl, komentovaný překlad, složeniny, překladatelské postupy, překladatelské transformace

ABSTRACT

This bachelor thesis deals with the translation of a didactic text from the electrical engineering field. The work aims to translate and analyze a didactic technical text and is divided into three main parts. The theoretical part introduces namely the characteristics of technical style and didactic style, types of translation procedures, translation transformation and the functional sentence perspective. The practical part presents an English translation of an excerpt taken from a university textbook and the analytic part aims presenting the problems that occurred during the translation process and the assessment of the characteristics of technical didactic style based on this translation analysis.

KEY WORDS

technical style, didactic style, commented translation, compound nouns, translation procedures, translation transformation

BIBLIOGRAFICKÁ CITACE VŠKP

MIČKOVÁ, D. *Komentovaný překlad odborného textu*. Brno: Vysoké učení technické v Brně, Fakulta elektrotechniky a komunikačních technologií, Ústav jazyků, 2015. 44 s. Vedoucí práce Mgr. Petra Langerová. Odborný konzultant prof. Dr. Ing. Zbyněk Raida.

PROHLÁŠENÍ

Prohlašuji, že svou bakalářskou práci na téma *Komentovaný překlad odborného textu* jsem vypracovala samostatně pod vedením vedoucího bakalářské práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v projektu a uvedeny v seznamu literatury na konci projektu.

Jako autor uvedené bakalářské práce dále prohlašuji, že v souvislosti s vytvořením této bakalářské práce jsem neporušila autorská práva třetích osob, zejména jsem nezasáhla nedovoleným způsobem do cizích autorských práv osobnostních a/nebo majetkových a jsem si plně vědoma následků porušení ustanovení § 11 a následujících zákona č. 121/2000 Sb., o právu autorském, o právech souvisejících s právem autorským a o změně některých zákonů (autorský zákon), ve znění pozdějších předpisů, včetně možných trestněprávních důsledků vyplývajících z ustanovení části druhé, hlavy VI. díl 4 Trestního zákoníku č. 40/2009 Sb.

V Brně dne 22. 5. 2015

.....

Daniela Mičková

ACKNOWLEDGEMENT

I would like to thank Mgr. Petra Langerová for her invaluable advices and patience. I would also like to thank prof. Dr. Ing. Zbyněk Raida for providing me with a text for my bachelor thesis and for his invaluable comments during the translation process.

TABLE OF CONTENTS

1	Introduction	8
2	Theoretical part.....	9
2.1	Professional discourse	9
2.2	Technical style and terminology	9
2.3	Didactic style.....	9
2.4	Types of translation.....	10
2.5	Translation transformation	11
2.5.1	Lexical transformation	12
2.5.2	Grammatical transformation	12
2.5.3	Lexical and grammatical transformation	12
2.6	Functional sentence perspective.....	13
3	Translation.....	14
4	Translation analysis	31
4.1	Lexical analysis of translation.....	31
4.1.1	Terminology.....	31
4.1.2	Lexical category and compounds.....	32
4.2	Translation transformation	33
4.2.1	Lexical transformation	33
4.2.2	Grammatical transformation	35
4.2.3	Lexical and grammatical transformation	37
4.2.4	Omission and abbreviations	38
4.3	Technical didactic style assessment	39
5	Conclusion.....	40
6	List of references	42
7	Attachments.....	44

1 INTRODUCTION

Nowadays, English takes over as a lingua franca in many branches, including science and technology, where communication is essential for the development. Therefore, it becomes more and more valuable to be familiar with technical terminology and professional discourse in general. Accordingly, university textbooks that would present the terminology of the given topic in English could be one of the best assets concerning this issue.

Electromagnetic waves and antennas is a text that is currently being written by prof. Dr. Ing. Zbyněk Raida. The text is bilingual and it is intended for electrical engineering students – it explains the topic both in Czech and English, thereby teaching the university students English expressions and terminology for the given topic in a simple way. The students also learn the structure of the sentences in technical style and should be able to talk about the topic as well as explain it in English.

This bachelor thesis is written in English and divided into three main parts – theoretical, practical and analytical.

The theoretical part of this bachelor thesis introduces a professional discourse and outlines the characteristics of a technical and didactic style. Further, translation procedures are given, where examples from the translation are written in italics, and examples from the source text are written in parentheses. After every example, the number of line from the translation follows, or, in the case of the source text, a page number is given. The theoretical part is concluded with the translation transformations and the concept of the functional sentence perspective.

The practical part presents an English translation of an excerpt of the second and third chapter taken from the university textbook *Electromagnetic waves and antennas*.

The analytical part aims analyzing the given translation and it is divided into three main parts – lexical analysis, translation transformations and the technical didactic style assessment. The lexical analysis mainly focuses on the lexical category percentage and the usage of compound words in the terminology. Translation transformations are divided into lexical transformations, grammatical transformations, and lexical and grammatical transformations. Each type of transformation is further divided, and examples from the translation are provided for each category. The analytical part is concluded with an assessment of the characteristics of technical and didactic style that occurred in the given translation.

The aims of this bachelor thesis are evaluated in the conclusion, followed by the list of references. The enclosed CD provides the source text for the translation.

2 THEORETICAL PART

2.1 Professional discourse

A discourse is basically a language in use; a professional discourse is thus a language used in a certain profession with specific characteristics that may differ according to the field of profession. This work focuses on the translation of a technical text which relates to the technical style.

2.2 Technical style and terminology

As Knittlová says, a technical style is primarily found in a written form; for even when it is spoken, it is usually prepared in the written form (e.g. lectures or presentations), therefore it is mainly monological. The main aim of technical style is to present information in such a way that the reader fully and entirely understands the subject matter (2010: 149). According to Knittlová, the main parameters of technical style are: “logical structure, coherence, objectivity, impersonality, non-emotionality, density, exactness and unambiguity” (2010: 169). Impersonality is achieved by using e.g. the passive voice (*The electric and magnetic field intensity of an electromagnetic wave propagating in the mentioned space is found by solving (3.1a, b).*); density is mainly gained through compound nouns and compound words in general (*electric field intensity vector E*). Objectivity goes hand in hand with non-emotionality – the findings are substantiated, passive voice is used; other features are accomplished by means of sentences with clear, logical structure. Another important feature of technical texts is the terminology.

In technical style, there is a high occurrence of technical terms and those terms “constitute a unique quality of a professional discourse, i. e., terminology” (Krhutová 2009: 107). Terms are stylistically neutral and facilitate the unambiguity and exactness of a technical text. Therefore, terms are not supposed to be translated literary, but an equivalent term in the target language is found (e.g. “měrný útlum” – *attenuation per unit length*).

The analyzed text is not only a technical text, but it is mainly intended for university students. As a university textbook, apart from technical style, it also belongs to the didactic style.

2.3 Didactic style

Every didactic text contains some expertise because every didactic text aims at teaching its readers about some field of knowledge. In this case, it is the field of electrical engineering. As Hausenblas says: “Many university textbooks share the essential features of technical texts (not only in the means of content by introducing new solutions to scientific problems but also considerably by the way they are presented) without losing the characteristic of a textbook, a

text with strong didactic style features” (1972: 157, translated by Mičková). Didactic style uses mainly personal phrases, such as *we will focus on, from our point of view, let us assume*, as it helps the student to imagine that he is concerned with the topic, thus, he better and faster understands it. Also, the text logically explains the topic step by step.

Hausenblas further implies that (technical) didactic style differs from popular scientific style mainly in the intended readers. Popular scientific texts are meant for any nonspecialist; technical didactic texts, on the other hand, are intended for people that are supposed to become experts in the given field. Therefore, they must be presented in such a way that the readers fully understand the topic (1972: 158).

2.4 Types of translation

According to Vinay and Dabernelt (1995), the following translation procedures are distinguished:

1. Transcription – there is a lot of transcription in the translation, as every equation is simply transcribed: $\nabla^2 \mathbf{H} + k^2 \mathbf{H} = \mathbf{0}$ (p. 1, line 17)
2. Calque – literal translation of a word or phrase (also every part of a closed compound noun is translated): “vlnová délka” (p. 4) is translated as *wavelength* (line 101)
3. Substitution – a term is substituted by an equivalent, usually a noun is substituted with a pronoun: “Na **této myšlence** je založena klasická teorie vedení.” (p. 12) is translated as *The classical transmission theory is based on **that***. (line 354)
4. Transposition – grammatical changes according to the target language (e.g. active voice to passive voice, swapping the noun and adjective): “Na obr. 4.2 jsou znázorněny siločáry elektrického a magnetického pole v příčném průřezu vedení.” (p. 10) is translated as *The lines of force of the electric and magnetic field in the cross section of the TL are illustrated in fig. 4.2.* (line 288)
5. Modulation – a change of the point of view: “...vodič, kterým **protéká** proud.” (p. 6) is translated as *...a current-**carrying** conductor.* (line 190)
6. Equivalence – usually used with proverbs, idioms or expressions which are well-established: “druhá odmocnina” (p. 6) is translated as *square root* (line 200)
7. Adaptation – the substitution of a certain phrase or term by an adequate equivalent in the target language: “Z Ampérova zákona celkového proudu...” (p. 10) is translated as *From the Ampère’s circuital law...* (line 291)
8. Borrowing – the source text has borrowed the term *TEM* (*transverse electromagnetic*) from English (line 165), in Czech “příčně elektromagnetická” (p. 5)

9. Literal translation – a phrase or word is replaced with a corresponding phrase or word in the target language: “**šíření** akustických a mechanických vln” (p. 1) is translated as *the propagation of acoustic and mechanical waves* (line 20)

According to Joseph Malone, the following types of translation are recognized:

1. Equality (EQU) – e.g. “vodivost” (p. 1) is translated as *conductance* (line 4)
2. Substitution (SUB) – e.g. “zápis (3.4b)” (p. 2) is translated as *the form(3.4b)* (line 55)
3. Divergence (DIV) – e.g. “zpětná vlna” (p. 4) can be translated as *back wave* or *backward wave*, the second term has been chosen for this translation (line 128)
4. Convergence (CNV) – e.g. “vlna/vlnění” (p. 1,2) are both translated as *wave* (line 29, 56)
5. Amplification (AMP) – e.g. “hledisko” (p. 1) is translated as *point of view* (line 36)
6. Reduction (RED) – e.g. “výše uvedené parametry” (p. 3) is translated as *the parameters above* (line 100)
7. Diffusion (DIF) – e.g. “vyfotografovat” (p. 3) is translated as *take a photograph* (line 94)
8. Condensation (CND) – e.g. “protékaný harmonickým proudem” (p. 6) is translated as *harmonic-current-carrying* (line 186)
9. Reordering (RRD) – e.g. “úbytek proudu” (p. 12) is translated as *current drop* (line 374)

(Malone 1988: 71)

Beside the translation procedures, the translator must also take into consideration the translation transformation.

2.5 Translation transformation

Man says: “A translation transformation is an operation that changes the unit being translated from the source language (SL) into a formally different one in the target language (TL), i.e. into its transform, while retaining the general invariant of the content” (1977: 54, translated by Mičková). Vysloužilová (2002) further divides the translation transformation into three main groups: lexical transformation, grammatical transformation, and lexical and grammatical transformation. Examples for each category will be presented and commented on in the translation analysis.

2.5.1 Lexical transformation

- Transcription and transliteration – English and Czech both use Roman characters so this transformation has not been used
- Calque – see chapter 2.4

Lexical-semantic transformations are the following:

- Concretization – substitution of a word or phrase with wider meaning for a word or phrase with narrow meaning
- Generalization – substitution of a word or phrase with narrow meaning for a word or phrase with wider meaning
- Modulation – substitution of a word or phrase from the source language for a target language unit, whose meaning can be logically deduced from the meaning of the source unit (thought ellipsis)

2.5.2 Grammatical transformation

- Sentence fragmentation
- Sentence integration
- Syntactic sentence compression – condensation of the sentence using e.g. adverbial participle or infinitive instead of a subordinate clause
- Part of speech replacement – e.g. noun is replaced with pronoun
- Sentence elements replacement – e.g. subject and object are switched
- Multiverbal and univocal units replacement – univocal units are created in case of diminished verb meaning, when the noun is the main information conveyor
- Passive and active voice replacement
- Word-order transformation

2.5.3 Lexical and grammatical transformation

- Antonymic translation – a positive utterance is replaced with negative one
- Amplification of a term - usually extends the meaning of the term in the source language

- Periphrastic translation – if there is no equivalent for a term in the target language, periphrastic translation is used explaining the meaning of the term
- Compensation – used e.g. for equivoques
- Total reinterpretation

(Vysloužilová 2002: 12)

When translating a technical text, terminology is the main information conveyor. Thus, terminology translation is the most demanding task, followed by the ever-present matter of functional sentence perspective.

2.6 Functional sentence perspective

The main issue that a translator encounters is the fact that English is an analytic language and Czech is a synthetic language. Thus, English relies much more on the word order than Czech that uses rather the Theme-Transition-Rheme concept.

“The involvement of sentence linearity is borne out, for instance, by the fact that the element towards which the communication within a clause, independent or subordinate, is perspectived tends to occupy the final position. This is invariably the case in the Czech text, in which the element that expresses a phenomenon to be presented, or a quality further unspecified, or a specification of a quality, always occupies the final position. In this way, the element carrying the highest degree of CD (communicative dynamism) closes the clause” (Firbas 1992: 8).

This application of the functional sentence perspective in Czech causes that most of the text sentences have to be reversed during the translation in such a way that they fit the grammatical needs of English. In Czech, the sentences in a technical text usually start with the old, known information (Theme) and then progress (Transition) to the new and important information (Rheme) which is easily done thanks to the features of synthetic language – mainly noun cases.

“In comparison with Czech, English is less ready to observe the Theme-Transition-Rheme sequence. This is because the grammatical principle renders English word order less flexible” (Firbas 1992: 119).

3 TRANSLATION

1 ELECTROMAGNETIC WAVES IN FREE SPACE

2 In the whole chapter, it will be assumed that we are situated in an unlimited
3 linear homogenous isotropic medium with the permittivity of $\varepsilon = \varepsilon_0 \varepsilon_r$, permeability
4 of $\mu = \mu_0 \mu_r$ and specific conductance γ . In addition, we will delimit ourselves to the
5 case when there is no presence of impressed currents J_i in the analyzed space and the
6 volume charge density ρ is zero. Only the presence of harmonic electromagnetic
7 field with angular frequency ω will be considered. The analyzed waves will be
8 assumed to be uniformed – i.e. the amplitude of electric and magnetic intensity on
9 the wavefront is constant. The wavefront is an area where the electric and magnetic
10 field intensity have constant phase.

11 The electromagnetic field that is created at a certain point of space does not fill
12 this space in an instant but rather propagates through it in a finite speed which is
13 dependent on the properties of the medium. If we are to analyze the field
14 propagation, the solution of equations that describe the field intensity vectors \mathbf{E} and
15 \mathbf{H} has to be found first.

16 Vectors \mathbf{H} and \mathbf{E} can be described by wave equations (2.32a, b)

$$17 \quad \nabla^2 \mathbf{H} + k^2 \mathbf{H} = \mathbf{0} \quad (3.1a)$$

$$18 \quad \nabla^2 \mathbf{E} + k^2 \mathbf{E} = \mathbf{0} \quad (3.1b)$$

19 The symbol k denotes wavenumber (2.33)

$$20 \quad k^2 = -j\omega\mu(\gamma + j\omega\varepsilon) \quad (3.2)$$

21 Eqn. (3.1a, b) got their name thanks to their similarity to equations which describe
22 the propagation of acoustic and mechanical waves. The electric and magnetic field
23 intensity of an electromagnetic wave propagating in the formerly mentioned space is
24 found by solving the equations (3.1a, b).

25 Let us assume that an omnidirectional point-source emitter is the source of the wave.
26 If, at a certain instance in time t_0 , a *picture* of generated electromagnetic field is
27 *taken*, it would become clear that the places with identical phase of electric or
28 magnetic intensity – wavefronts – are centric spherical surfaces with the centre in the
29 point-source emitter. Thus, we can say that a *spherical wave* is propagating through
30 space. The common centre of the spherical wavefronts is called the *phase centre*.

31 If the source of the wave is a harmonic current which flows through an infinitely
32 long straight conductor, then the wavefronts are cylindrical and we are discussing the
33 *cylindrical wave* propagation.

34 If the spherical or cylindrical wave is observed from a place which is *almost*
35 *infinitely* distant from the source, then the wavefront curvature would be so small
36 that the wavefront could be considered planar. From our point of view, *a plane wave*
37 will be propagating in the space.

38 **Plane wave propagation**

39 The Cartesian coordinate system will be used for the solution of wave
40 equations; the system will be directed in such a way that the z-axis is orientated to
41 the direction of the wave propagation, and the vector of electric intensity \mathbf{E} lies on
42 the x-axis. The only nonzero component of the vector \mathbf{E} is therefore E_x .

43 The amplitude of the electric intensity nonzero component E_x will be changing
44 only in the direction of propagation z ; it will be decreasing due to the attenuation.
45 The amplitude E_x is constant in the direction of x and y – i.e. on the wavefront – due
46 to the anticipated uniformity of the wave; which means that all partial derivations
47 with respect to x and y will be equal to zero. The vector equation (3.1b) thereby shifts
48 to a single scalar equation

$$49 \quad \frac{d^2 E_x}{dz^2} + k^2 E_x = 0 \quad (3.3)$$

50 A general solution of eqn. (3.3) can be expressed in two equivalent ways, through
51 exponentials

$$52 \quad E_x = A \exp(-jkz) + B \exp(+jkz) \quad (3.4a)$$

53 or through goniometric functions

$$54 \quad E_x = A' \sin(kz) + B' \cos(kz) \quad (3.4b)$$

55 The A , B , A' and B' symbols are constants of integration. The form (3.4b) is preferred
56 in a case when there is anticipated formation of a standing wave – the primary wave
57 coming from the source is added to (interferes with) the secondary wave that is
58 formed through reflecting the primary wave of inhomogeneous space. As we will be
59 discussing the wave propagation, the form (3.4a) will be preferred.

60 In the form (3.4a), the wavenumber k plays an important role. Therefore, we
 61 will now focus on that. Firstly, the relation (3.2) has to be rewritten as follows

$$62 \quad k^2 = -j\omega\mu j\omega(\varepsilon - j\gamma/\omega) \quad (3.5)$$

63 The expression in parentheses will be called the complex permittivity of a medium
 64 $\tilde{\varepsilon}$. According to this denotation, our relation for wavenumber gets significantly
 65 simpler.

$$66 \quad k^2 = \omega^2 \mu \tilde{\varepsilon} \quad (3.6)$$

67 Now let us extract the wavenumber (3.6) and consider the positive root only. While
 68 ω^2 and μ are positive real numbers and thus their square roots will also be positive
 69 real numbers, $\tilde{\varepsilon}$ is a complex number with negative argument whose square root is
 70 also complex number with negative argument. The positive root k can therefore be
 71 written as follows

$$72 \quad k = k' - jk'' \quad (3.7)$$

73 The result (3.7) is substituted separately into the first and into the second addend in
 74 (3.4a). That way their physical significance can be better distinguished

$$75 \quad E_x(z) = A \exp[-j(k' - jk'')z] = A \exp(-k''z) \exp(-jk'z) \quad (3.8)$$

76 Let us realize that we are working with the phasors. Thus, the considered
 77 electric field intensity has also its time dimension

$$78 \quad E_x(z, t) = A \exp(-k''z) \exp[j(\omega t - k'z)] \quad (3.9)$$

79 As has been mentioned in the first chapter, the real signal makes the real part of
 80 phasor function:

$$81 \quad E_x(z, t) = A \exp(-k''z) \cos(\omega t - k'z) \quad (3.10)$$

82 From the obtained relation arises the physical meaning of the constants:

- 83
- 84 • The symbol A denotes the amplitude of the x component of an electric
 intensity vector at the origin of the coordinate system $A = E_x(z=0)$.
 - 85 • The k'' [m^{-1}] symbol is so-called *attenuation per unit length*. It describes the
 86 decrease in the wave amplitude in the direction of z-axis, i.e. in the direction
 87 of propagation. The wave induces currents in a medium and they are heating
 88 that medium due to the nonzero medium conductance γ . All of that happens at
 89 the expense of the wave energy.

90 • The k' [$\text{rad}\cdot\text{m}^{-1}$] symbol is so-called *phase constant*. It tells us of how many
91 radians the phase of a wave changes on its photograph¹ at a distance $z = 1$ m.

92 Eqn. (3.10) also illustrates the spatiotemporal pattern of a wave. If the observer
93 stands in the place $z = z_0$, then the wave acts as a harmonic function in time. If the
94 observer takes a photograph of the wave in the time $t = t_0$, he will see the wave on
95 the photograph as a harmonic function in space.

96 The cosine argument (3.10) shows that the time component ωt differs from the
97 space component kz in sign. Whether the time component is positive and the space
98 component is negative or whether it is vice versa, depends on the stipulation. In this
99 case, the signs will be used as they are used in (3.10).

100 Beside the parameters above, wave is described by its phase velocity and
101 wavelength.

102 Let us imagine that on the wavefront (x, y, z_0) in time t_0 is a phase

$$103 \quad \phi_0 = \omega t_0 - k'z_0 \quad (3.11)$$

104 The phase velocity v_f [$\text{m}\cdot\text{s}^{-1}$] determines the distance z , that our wavefront with the
105 phase ϕ_0 has travelled in one second, thus

$$106 \quad v_f = \frac{dz}{dt} = \frac{d}{dt} \left(\frac{\omega}{k'} t - \frac{\phi_0}{k'} \right) \quad (3.12)$$

107 Given that ω , k' and ϕ_0 are constants, the result of the indicated derivation is

$$108 \quad v_f = \omega/k' \quad (3.13)$$

109 The wavelength λ [m] determines the distance that the wavefront with phase ϕ_0
110 travels during a period of time that is equal to a time period of the wave T [s]

$$111 \quad \lambda = v_f T = v_f / f \quad (3.14)$$

112 where f [Hz] is the wave frequency and $f = T^{-1}$. This means that the phase shift
113 between two points on the z -axis that are at a distance λ is 2π radians.

¹ To imagine a field in time and in space simultaneously is very difficult. Therefore, if we are interested only in the spatial distribution of a wave, the time is stopped (*a photograph of the field is taken* and the dependence on the spatial coordinates in a single time instant $t = t_0$ is computed).

114 Given, that the real part of the wavenumber determines of how many radians the
 115 phase changes at the distance of one meter on the z-axis, k' can be expressed using
 116 the wavelength:

117
$$k' = 2\pi/\lambda \tag{3.15}$$

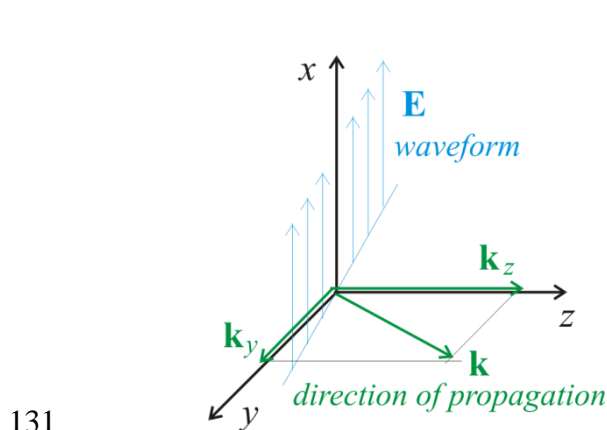
118 Now let us get back to the general solution of the wave equation (3.4a) and let us
 119 focus on the second addend. The real spatiotemporal signal that is adequate to this
 120 component is

121
$$E_x(z,t) = A \exp(k''z) \cos(\omega t + k'z) \tag{3.16}$$

122 The phase velocity arising from the goniometric function argument in (3.16) is given
 123 by

124
$$v_f = -\omega/k' \tag{3.17}$$

125 As can be seen, the phase velocity is oriented to the $-z$ direction and the amplitude of
 126 the function (3.16) decreases in the $-z$ direction. We can say from the practical
 127 experience that (3.16) describes an electric intensity of a planar harmonic wave
 128 propagating to the $-z$ direction. This wave is so-called *backward wave* and, as has
 129 been already said, it is formed for example by the reflection of a *straight travelling*
 130 *wave* of some inhomogeneity of a medium.



132 Fig. 3.1 The propagation of a plane
 133 wave in a general direction.

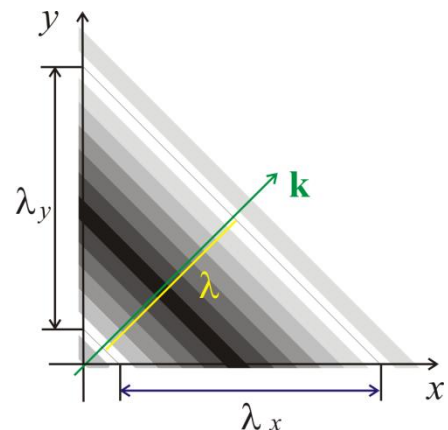


Fig. 3.2 The top view on a plane wave
 (maximum: black, minimum: white)

134 The wavenumber behaves as a vector. The magnitude of a *wave vector* is given
 135 by eqn. (3.2); its direction is equal to the direction of wave propagation. In our
 136 situation, the wave vector would be $\mathbf{k} = kz$. If the coordinate system is shifted an
 137 angle α (see Fig. 3.1), the wave vector has beside the z component also the nonzero y
 138 component. The components are computed the classical way; for example, for the
 139 real components of \mathbf{k} holds:

$$140 \quad k'_z = |\mathbf{k}'| \cos(\alpha) \quad (3.18a)$$

$$141 \quad k'_y = |\mathbf{k}'| \sin(\alpha) \quad (3.18b)$$

142 The phase velocities in the directions of coordinate axes are computed in the
 143 following way:

$$144 \quad v_{fy} = \frac{\omega}{k'_y} = \frac{\omega}{|\mathbf{k}'| \sin(\alpha)} = \frac{v_f}{\sin(\alpha)} \quad (3.19)$$

145 Similar procedure is taken while computing the wavelength in directions of
 146 coordinate axes

$$147 \quad \lambda_y = \frac{2\pi}{k'_y} = \frac{2\pi}{|\mathbf{k}'| \sin(\alpha)} = \frac{\lambda}{\sin(\alpha)} \quad (3.20)$$

148 The fact that the wavelength increases with the increase in the angle between the
 149 direction of propagation and direction in which we compute the wavelength, is
 150 shown in Fig. 3.1. If the wavelength increases in a certain direction, then also the
 151 phase velocity has to increase because the phase then must travel longer distance
 152 during the period T .

153 Let us further focus on the wave intensity vector of the magnetic field \mathbf{H} . We
 154 will get it by solving the wave equation (3.1a) or by substituting the solved electric
 155 field intensity \mathbf{E} into the second Maxwell equation:

$$156 \quad \mathbf{H} = \frac{j}{\omega\mu} \nabla \times \mathbf{E} \quad (3.21)$$

157 Individual components of the magnetic intensity vector are then given by

$$158 \quad H_x = H_z = 0 \quad (3.22a)$$

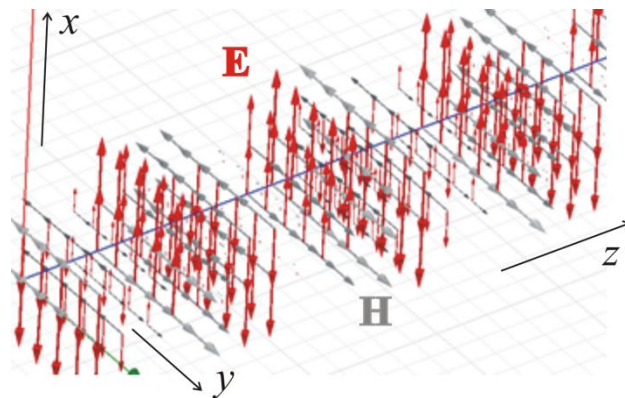
$$159 \quad H_y = \sqrt{\frac{\gamma + j\omega\epsilon}{j\omega\mu}} E_x \quad (3.22b)$$

160 The constant of the proportionality between the electric and magnetic intensity

161
$$Z_0 = \sqrt{\mu/\tilde{\epsilon}} \tag{3.23}$$

162 is called the *wave impedance of a medium* Z_0 [Ω].

163 Notice that the vectors of electric and magnetic intensity are perpendicular to
164 each other. Both are also perpendicular to the direction of propagation. Therefore, we
165 can say that the plane wave in a free space is *transverse electromagnetic* (TEM).
166 Thus, the electric and magnetic intensity vectors do not have *longitudinal*
167 components or in other words their components that are parallel with the direction of
168 propagation are equal to zero (see Fig. 3.3).



169

170 Fig. 3.3 The intensity of a plane wave

171 coordinate

172 in free space.

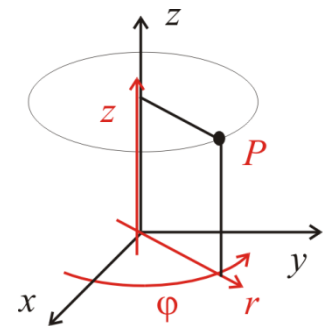


Fig. 3.4 The cylindrical

172 system (r, φ, z).

173 Fig. 3.3 shows the instantaneous magnitude of the vectors **E** and **H** in a time
174 instant t_0 on the z -axis. With regard to the uniformity of the wave, this figure also
175 stands for any line that is parallel with the z -axis. The figure is drawn for a lossless
176 medium. Therefore, the electric and magnetic intensity are in phase shifted and their
177 amplitudes do not decrease.

178 Let us further mention the Poynting vector

179
$$\mathbf{\Pi} = \mathbf{E} \times \mathbf{H}^* \tag{3.24}$$

180 The direction of Poynting vector is identical with the direction of propagation and its
181 magnitude signifies the power density carried by an electromagnetic wave. In eqn.
182 (3.24) the symbol \times stands for the cross product and $*$ stands for the complex
183 conjugation of \mathbf{H}^2 components.

184 **Cylindrical wave propagation**

185 As has been already mentioned, the source of harmonic cylindrical wave is
186 infinitely long, straight, harmonic-current-carrying conductor. The cylindrical
187 coordinate system in which the problem will be solved is directed in such a way that
188 the z-axis is identical with the source-current-carrying conductor (Fig. 3.4). Then the
189 wavefront equation is $r = \text{const}$.

190 The current density vector \mathbf{J} has the same direction as the current-carrying
191 conductor. In this case, \mathbf{J} has only the z component. The magnitude of an electric
192 field intensity z component far distant from the conductor ($kr \gg 1$) can be found by
193 a relatively complex computation from the J_z component

$$194 \quad E_z = C \sqrt{\frac{1}{kr}} \exp(-jkr) \quad (3.25)$$

195 where k is the wavenumber, r is the radial distance from the conductor axis and C is
196 the source constant.

197 We can see that the phase of the cylindrical wave changes according to the
198 distance – same as the phase of plane wave. The cylindrical wave amplitude
199 reduction in the direction of propagation even in a lossless medium (wavenumber k is
200 a real number) is inversely proportional, with the square root of the distance r . The
201 fact, that we would reach such a result could be after all expected:

- 202 • The term $\exp(-jkr)$ describes the travelling wave propagating radially from the
203 conductor axis.
- 204 • The magnitude of the electric intensity amplitude E must be so high that the
205 power passing through random cylindrical area \mathbf{S} , whose longitudinal axis is
206 identical to the source conductor, is always equal to the power radiated by the
207 wave source P_{Σ} (in a lossless medium the wave energy cannot be lost).

² The reason for complex conjugation of vector \mathbf{H} is the same as the one in the circuit theory. Here, the current $P=UI^*$ is, in the complex power computation, complexly associated: the phase of the complex power depends on the phase shift between the voltage and current and therefore the phase of the current must be *subtracted* from the phase of the voltage. If we do not use the complex conjugated current for the computation of the complex power, the phases of current and voltage would be in the multiplication *added up*.

208 For a uniform wave propagating in the direction of \mathbf{r} is this power far distant
209 from the source³ given by the relation

$$210 \quad P_{\Sigma} = \Pi \cdot \mathbf{S} = \frac{1}{2} \frac{E^2}{Z_0} 2\pi r z = \text{const} \quad (3.26)$$

211 To guarantee the validity of eqn. (3.26), the magnitude of the electric field
212 intensity must be inversely proportional to the square root of the radial distance
213 from the conductor axis $E^2 \approx 1/r$.

214 **Spherical wave propagation**

215 The general analysis of the spherical wave propagation is mathematically even
216 more demanding than of cylindrical wave. Therefore, let us state only the solution:
217 for the electric field intensity of uniform wave far distant from the source ($kr \gg 1$)
218 holds

$$219 \quad E = C \exp(-jkr)/r \quad (3.27)$$

220 where C is the source constant.

221 In a lossless medium, where the wavenumber k is a real number:

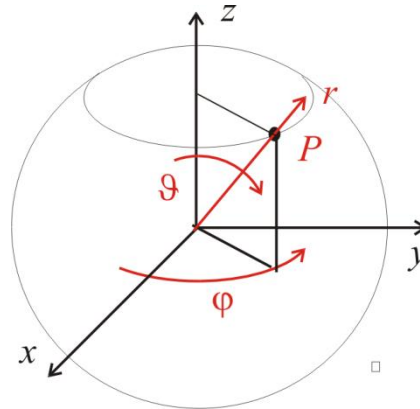
- 222 • The phase of a spherical wave changes in the same way as in plane or
223 cylindrical wave.
- 224 • The amplitude of the spherical wave reducing in the direction of propagation is
225 inversely proportional to the power of one of distance r . The power passing
226 through random spherical area with the centre in the source must be constant in
227 a lossless medium

$$228 \quad P_{\Sigma} = \Pi \cdot \mathbf{S} = \frac{1}{2} \frac{E^2}{Z_0} 4\pi r^2 = \text{const} \quad (3.28)$$

229 To guarantee the validity of the eqn. (3.28), the magnitude of the electric field
230 intensity must be inversely proportional to the radial distance from the
231 conductor axis $E^2 \approx 1/r^2$.

³ Far distant from the source, the characteristics of cylindrical wave start to resemble the characteristics of the plane wave: vectors \mathbf{E} and \mathbf{H} are perpendicular to each other and for their magnitudes apply $E/H=Z_0$.

232 As the spherical wave is important for our further studies, we will assess the
 233 value of the source constant C featured in eqn. (3.27). We will assume that our
 234 spherical uniform wave is produced by the omnidirectional (isotropic) point source.
 235 Let us further assume that, as in cylindrical wave, the characteristics of the spherical
 236 wave are similar to the characteristics of the plane wave and therefore the power
 237 passing through random spherical area with the centre in a source equals the power
 238 emitted by the source (see eqn. 3.28).



239

240

Fig. 3.5 Spherical coordinate system.

241 If we know the power emitted by the source P_{Σ} , then, after substituting (3.27)
 242 into (3.28), the source constant can be computed

$$243 \quad C^2 = P_{\Sigma} \frac{Z_0}{2\pi} \quad (3.29)$$

244 Since in lossless space the wave impedance is as follows

$$245 \quad Z_0 = 120\pi\sqrt{\mu_r/\epsilon_r} \quad (3.30)$$

246 the eqn. (3.29) shifts to

$$247 \quad C = \sqrt{60P_{\Sigma}} \sqrt[4]{\mu_r/\epsilon_r} \quad (3.31)$$

248 Based on (3.27) and (3.31) we can state the relation for the electric intensity
 249 effective value of the spherical wave at a distance r from the source

$$250 \quad E_{ef} = \frac{\sqrt{30P_{\Sigma}}}{r} \sqrt[4]{\frac{\mu_r}{\epsilon_r}} \quad (3.32)$$

251 The real sources are never isotropic in practice. That does not change anything
252 about the nature of the spherical wave. Only the field intensities in different
253 directions have different magnitudes, i. e. the wave is not uniform. This fact is often
254 respected by the directional coefficient $D(\varphi, \vartheta)$, which is added under the square root
255 in eqn. (3.32)

$$256 \quad E_{ef} = \frac{\sqrt{30P_{\Sigma}D(\varphi, \vartheta)}}{r} \sqrt[4]{\frac{\mu_r}{\varepsilon_r}} \quad (3.33)$$

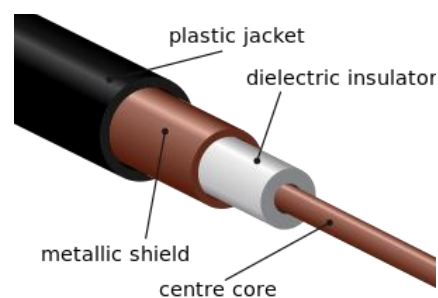
257 The quantity $D(\varphi, \vartheta)$ is called the *directivity factor* of the source. The directivity
258 factor D is bigger than one in those directions, where the source concentrates the
259 radiation, and it is lesser than one in those directions, where the radiation is
260 suppressed. The directivity factor of the omnidirectional source is for all directions
261 equal to zero.

262 TRANSMISSION LINES

263 In the previous chapter, we have focused on the propagation of electromagnetic
264 waves in free space. The wave propagated from its source (transmitting antenna) to
265 the whole area that surrounded the wave. Thus, a space of any size could be filled
266 with the signal (in ideal case). The wave propagation through free space is therefore
267 conveniently used for the distribution of cable television signal or for covering an
268 area with the mobile communication services signal.

269 Although, if we want to deliver the signal to a single place (e. g. from the
270 receiving antenna output to the TV receiver input), it is more convenient to use
271 transmission lines (TL).

272 A coaxial cable (Fig. 4.1) is the most frequently used TL. The electromagnetic
273 field in a coaxial cable is “trapped” in dielectric between the outer and inner
274 conductors. The wave propagates in the direction of the TL axis.



275

276

277

Fig. 4.1 Coaxial transmission line.

Source: http://en.wikipedia.org/wiki/coaxial_cable

278 Let us assume that the TL we work with consists of PEC (perfect electrically
279 conducting) inner and outer conductors. The constant distance between inner and
280 outer conductors is acquired thanks to the lossless homogeneous dielectric filler with
281 permittivity ε and permeability μ .

282 The TL is fed by a harmonic current. With the proper source connection on the TL
283 input and the proper load connection on the TL output, the current flowing through
284 the inner conductor in the direction of z equals the current that returns from the
285 direction of $-z$ along the inner wall of the outer conductor. The TL is configured in
286 such a way to consume all the energy that the generator is fed with in the load and
287 does not reflect any of it back.

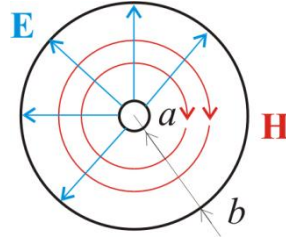
288 The lines of force of the electric and magnetic field in the cross section of the TL are
289 illustrated in fig. 4.2. Thanks to the high electrical conductivity of the inner and outer
290 conductors, the electric field intensity is perpendicular to the conductors' surfaces
291 (the component that is tangential to the surfaces must equal zero). From the Ampère's
292 circuital law it is clear that the magnetic field lines of force have the shape of centric
293 circles with their centre located on the coaxial TL axis. The magnetic lines of force
294 are thus perpendicular to the electric lines of force. The electric and magnetic lines of
295 force are simultaneously perpendicular to the direction of propagation. The
296 electromagnetic wave transversely (TEM – transverse electro-magnetic) propagates
297 along the coaxial TL

298 When working with the TL, it is easier to use the scalar voltage U and current I
299 instead of the vector field intensities \mathbf{E} and \mathbf{H} .

300 Firstly, the magnitude of the electric field intensity is going to be expressed.
301 Let us consider Gauss' law:

$$302 \quad \oiint_S \mathbf{D} \cdot d\mathbf{S} = \tau \Delta \quad (4.1)$$

303 The symbol τ denotes the longitudinal charge density in the inner conductor and Δ is
 304 a very small segment of the examined TL. The right side (4.1) thus reflects the total
 305 charge of that conductor part.



306

307 Fig. 4.2 Field distribution in the cross section
 308 of a coaxial transmission line.

309 If we surround the conductor segment with a cylindrical plane with the radius
 310 r , the electric induction flux that is given by the following charge (eqn. (4.2)) must
 311 go through the plane $S = 2\pi r \Delta$

312
$$\varepsilon E 2\pi r \Delta = \tau \Delta \quad (4.2)$$

313 When deriving (4.2), we have assumed that the magnitude of the electric induction ε
 314 \mathbf{E} on a cylindrical plane is constant. The symbol ε stands for the dielectric
 315 permittivity between the inner and outer conductors.

316 From eqn. (4.2), the magnitude of the radial electric field intensity can be expressed

317
$$E(r) = \frac{\tau}{2\pi \varepsilon} \frac{1}{r} \quad (4.3)$$

318 Subsequently, the voltage between inner and outer conductors will be obtained by
 319 successive adding of elementary voltages $du = E(r) dr$ in the radial direction

320
$$U = \int_a^b E(r) dr = \frac{\tau}{2\pi \varepsilon} \ln\left(\frac{b}{a}\right) \quad (4.4)$$

321 where a is the radius of the inner conductor and b is the radius of the outer
 322 conductor.

323 Further, we can derive from (4.3) the following

$$324 \quad \frac{\tau}{2\pi\epsilon} = E(r)r$$

325 and substitute it into (4.4)

$$326 \quad U = E(r)r \ln\left(\frac{b}{a}\right) \quad (4.5)$$

327 With that, we pass from the electric field intensity to the voltage.

328 The relation between the magnetic field intensity and the current is given by
329 the Ampère's circuital law

$$330 \quad \oint_l \mathbf{H} \cdot d\mathbf{l} = I + d\psi/dt \quad (4.6)$$

331 We will integrate over an arbitrary circle that lies in the transverse plane and its
332 centre is on the conductor axis. Considering the circular symmetry of the TL, the
333 magnitude of that circle's magnetic intensity will be constant.

334 The electric induction flux ψ through the circle area is zero because the vector
335 of that plane \mathbf{S} (in the direction of \mathbf{z}) and the vector of the electric induction \mathbf{D} (in the
336 direction of \mathbf{r}) are perpendicular to each other.

337 Considering the facts stated above, the eqn. (4.6) shifts to

$$338 \quad I = 2\pi rH \quad (4.7)$$

339 If we establish the characteristic impedance of the transmission line Z_V to be
340 the quotient of the voltage and the current in a certain segment of the TL, based on
341 (4.5) and (4.7), we get the following relation

$$342 \quad Z_V = \frac{U}{I} = \frac{1}{2\pi} \frac{E}{H} \ln \frac{b}{a} \quad (4.8)$$

343 If we substitute the quotient of the electric and magnetic field intensities with the
344 wave impedance of a TEM wave in a lossless dielectric, we get the following relation

$$345 \quad Z_V = \frac{1}{2\pi} \sqrt{\frac{\mu}{\epsilon}} \ln \frac{b}{a} \quad (4.9)$$

346 Thanks to the steps stated above, we have moved during the analysis of the coaxial
347 TL from the electric field intensity vector \mathbf{E} to the scalar voltage between the TL
348 conductors U and from the magnetic field intensity vector \mathbf{H} to the scalar conductor
349 current I . Instead of describing the TL with the dielectric permittivity and
350 permeability between conductors, we can express the parameters of the TL by
351 capacity and inductance per one meter.

352 Based on the parameters stated above, we can make an equivalent TL circuit that is
353 made of the circuit components with focused parameters and the TL can be analyzed
354 using the things known from the circuit theory. The classical transmission line theory
355 is based on that.

356 **Transmission line theory**

357 For a better picture, let us consider the classical twisted pair as the
358 representative of homogeneous two-conductor transmission lines. There is no doubt
359 that every conductor of the twisted pair will have its own inductance L and resistance
360 R . Also, it is clear that there will be a mutual capacitance C between the twisted pair
361 conductors. If the dielectric between the conductors is not perfect, the transverse
362 conductive current will flow through; that is expressed by the transverse conductivity
363 G .

364 It is clear that with the increase in TL length, the total resistance, inductance,
365 capacitance, and conductivity will increase as well. To get rid of this length
366 dependence of the parameters, we establish an inductance per meter L_1 [H.m^{-1}], a
367 resistance per meter R_1 [$\Omega.\text{m}^{-1}$], a capacitance per meter C_1 [F.m^{-1}] and a
368 conductivity per meter G_1 [S.m^{-1}].

369 The voltage drop on the elementary part of the TL dz is caused by a longitudinal
370 impedance per meter

$$371 \quad Z_1 = R_1 + j\omega L_1 \quad (4.10)$$

372 or

$$373 \quad -dU = I Z_1 dz \quad (4.11)$$

374 In contrast, the current drop on the elementary part of the TL dz is caused by a
 375 transverse admittance per meter

$$376 \quad Y_1 = G_1 + j\omega C_1 \quad (4.12)$$

377 or

$$378 \quad -dI = U Y_1 dz \quad (4.13)$$

379 If we divide both sides of equations (4.11) and (4.13) by the elementary length dz ,
 380 we get

$$381 \quad -dU/dz = I Z_1 \quad (4.14a)$$

$$382 \quad -dI/dz = U Y_1 \quad (4.14b)$$

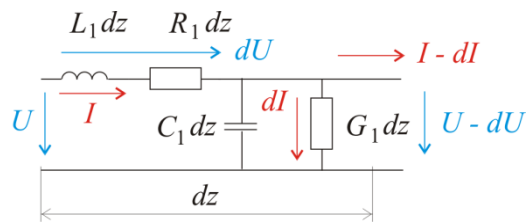
383 Now both sides of eqn. (4.14a) are derived with respect to z and the right side from
 384 (4.14b) is substituted into the right side from (4.14a) for dI/dz

$$385 \quad d^2U/dz^2 = U Z_1 Y_1 \quad (4.15a)$$

386 Similarly, by deriving (4.14b) with respect to z and by substituting it into (4.14a) in
 387 the place of dU/dz , we get

$$388 \quad d^2I/dz^2 = I Z_1 Y_1 \quad (4.15b)$$

389 Equations (4.15) are called the *telegraphic equations*.



390

391 Fig. 4.3 Equivalent circuit of a two-wire transmission line.

392 The general solution for a voltage differential equation (4.15a) can be written
 393 as follows

$$394 \quad U(z) = A \exp(-\gamma z) + B \exp(+\gamma z) \quad (4.16a)$$

395 where

$$396 \quad \gamma = \sqrt{(R_1 + j\omega L_1)(G_1 + j\omega C_1)} \quad (4.17)$$

397 is so-called propagation constant or transmission coefficient.

398 By substituting (4.16a) into (4.14b) and then by integrating the relation, we get

$$399 \quad I(z) = \frac{1}{Z_v} [A \exp(-\gamma z) - B \exp(+\gamma z)] \quad (4.16b)$$

400 where

$$401 \quad Z_v = \sqrt{\frac{R_1 + j\omega L_1}{G_1 + j\omega C_1}} \quad (4.18)$$

402 is so-called characteristic TL impedance.

403 From the equations (4.16) can be seen that the distribution of voltage $U(z)$ and
404 current $I(z)$ is expressed by similar eqn. that we used to describe the distribution of
405 electric and magnetic field intensity of planar wave in the direction of propagation.
406 Based on that analogy we can directly explain the physical significance of equations
407 (4.14):

- 408 • The term $\exp(-\gamma z)$ denotes the voltage, or current of the wave that propagates
409 in the direction of z axis – from the source to the load. This wave is called a
410 *forward wave* and it will be denoted by the upper index P : $U^P(z)$, $I^P(z)$. The
411 integration constant A , or A/Z_{0V} , gives the voltage or current of a forward wave
412 on the beginning of the TL $z = 0$.
- 413 • The term $\exp(+\gamma z)$ denotes the voltage, or current of the wave that propagates
414 against the direction of z axis – from the load to the source. This wave is called
415 *backward wave* or *reflected wave* and will be denoted by the upper index Z :
416 $U^Z(z)$, $I^Z(z)$. The integration constant B , or B/Z_{0V} gives the voltage, or current of
417 the backward wave on the beginning of the TL $z = 0$.

418 From the technical point of view, it is more suitable to express voltage and current
419 according to the distance from the *end* of the TL. Voltage and current ratios on the
420 TL are, as we are going to discover, heavily influenced by the terminating impedance
421 Z_k .

4 TRANSLATION ANALYSIS

The linguistic analysis of translation will comprise lexical analysis and translation transformation (lexical transformation, grammatical transformation, and lexical and grammatical transformation). This chapter is concluded with an assessment of technical didactic style based on the translation analysis.

4.1 Lexical analysis of translation

4.1.1 Terminology

The text *Electromagnetic waves and antennas* is from the electrical engineering field. The translated excerpt is taken from the second and third chapter of *Electromagnetic waves and antennas*, where the basics needed for the understanding of the topic are explained; thus, many math and physics terms are used in the text, as on those fields electrical engineering is based.

Electrical engineering as well as its terminology is still developing. It is reflected by the fact that the terms from electrical engineering considering the analyzed terminology, are the latest to be formed, e. g. *antenna* and *phase (shift)* are from the 20th century, unlike math terms which were mostly formed in the 14th or 15th century and physics terms which were mostly formed in the 18th century (according to www.etymonline.com).

In total, 190 terms have been chosen for the lexical analysis. The terms that have been chosen have the following property:

- Their meaning in technical texts is different than it is in other types of texts.
 - e.g. *positive (root)* means bigger than zero in technical texts, *sign* means the plus or minus *sign* in front of a number, etc.

To avoid duplicates, the following rule has been applied:

- If a term is to be counted more than once, then when one of the nouns in the compound changes, it must considerably change the meaning of the term.
 - e.g. *electric field intensity* and *magnetic field intensity* are counted as two terms, as the compounds *electric field/magnetic field* modify the noun *intensity*, and electric and magnetic fields have different properties
 - counted ONCE: e.g. *z-axis* or *conductor axis*, because it always refers to some axis in the given coordinate system, the first part of the compound only slightly modifies the meaning of the whole term (only values on the axis change)

4.1.2 Lexical category and compounds

	Number of terms	Percentage
Noun	50	26.32 %
Compound noun	97	51.05 %
Adjective	29	15.26 %
Compound adjective	4	2.11 %
Verb	10	5.26 %
Total	190	100 %

Tab. 4-1 Table of lexical category percentage

It can be seen from the Tab. 4-1, that overall 77.37 % of the analyzed terminology were either nouns or compound nouns, which is typical for the technical style. The technical style is dense, objective, exact and unambiguous – all these features are mainly facilitated by terms. In technical text, the specificity is usually provided by the subject and object, thus, there is no need for specific technical verbs. This is the reason, why more than three-fourths of the terminology used composes of nouns or compound nouns and only 5.26 % are verbs. Specific technical adjectives were also not used as much, they correspond to 15.26 % of the analyzed terminology, because a term is usually further specified by modifying a noun by another noun, thereby creating a compound noun. A specific table concerning compounds that occurred in the translation is given below.

	Number of terms	Percentage
A(adjective) + N(noun)	45	45 %
N + N	37	37 %
Adverb + A	2	2 %
A + A	1	1 %
A + A + N	2	2 %
A + N + N	4	4 %
N + N + N	3	3 %
Compound with possessive pronoun	1	1 %
Noun with prepositional phrase	5	5 %
Total	100	100 %

Tab. 4-2 Compound words percentage

Compound words can be in an open form (e.g. *partial derivation*), a hyphenated form (e.g. *harmonic-current-carrying*) or in a closed form (e.g. *wavefront*). In the text, there were two-word compounds made of adjective plus noun (e.g. *angular frequency*, *electric intensity*,

twisted pair), noun plus noun (e.g. *length dependence, propagation constant, wave uniformity*), adverb plus adjective (*complexly associated, inversely proportional*), and one case of adjective plus adjective (*transverse electromagnetic*). Then there were compounds made of three words – adjective plus adjective plus noun (*planar harmonic wave, straight travelling wave*), adjective plus noun plus noun (*Cartesian coordinate system, electric field intensity, electric induction flux, magnetic field intensity*), noun plus noun plus noun (*field intensity vector, volume charge density, wave intensity vector*), and one case of a compound using the possessive pronoun (*Ampere's circuital law*). Compound words can be also formed with prepositions, in the analyzed terminology there were compound nouns with prepositional phrases (*capacity per one meter, inductance per one meter, attenuation per unit length, lines of force, wave impedance of a medium*); also verbs with prepositions (phrasal verbs) (*derive with respect to, integrate over*) could be found in the translation.

It can be seen from the Tab. 4-1 that the excerpt is a typical technical text; as Knittlová says: “The scientific style is term-oriented; nouns and eventually adjectives are the typical parts of speech.” (2010: 149). Technical text is also very semantically dense – for that purpose compound words are used. We can see from Tab. 4-1 and 4-2 that there were 190 analyzed terms, from which 100 terms were compounds. Therefore, compounds accounted for 52.63 % of the analyzed terminology.

4.2 Translation transformation

Translation transformations deal with the necessary changes in the text. The technical style is term-oriented, therefore, lexical transformations have not been used much. On the other hand, grammatical transformations had to be used many times due to the different emphasis on the SVO word-order (subject-verb-object) in Czech and English.

4.2.1 Lexical transformation

There are given only those types of lexical transformation that are relevant to the given translation. In the translation, concretization and generalization were not used as much as modulation.

4.2.1.1 Concretization

The technical style is usually so exact that there is no need or possibility for the translator to further concretize the text. Therefore, only one example of concretization has been found.

“Velikost amplitudy elektrické intenzity E musí být **taková**, aby výkon...” (p. 7)

*The magnitude of the electric intensity amplitude E must be **so high** that the power...* (line 204)

4.2.1.2 Generalization

As has been said above – the technical style is exact, thus, it is not advisable to generalize the text.

“Vlnoplochou **rozumíme** plochu, na které mají intenzita elektrického a magnetického pole konstantní fázi.“ (p. 1)

The wavefront is an area where the electric and magnetic field intensity have constant phase. (line 9)

“**Vyjdeme** přitom z Gaussova zákona“ (p. 10)

Let us consider Gauss' law (line 301)

4.2.1.3 Modulation

As English and Czech are different types of languages, the modulation had to be used frequently.

“**Chceme-li** toto šíření pole **analyzovat**, musíme nalézt řešení rovnic, jimiž jsou popsány vektory intenzity pole **E** a **H**.“ (p. 1)

*If we are to analyze the field propagation, the solution of equations that describe the field intensity vectors **E** and **H** has to be found first.* (line 13)

“Vyřešením rovnic (3.1a, b) nalezneme intenzitu elektrického a magnetického pole elektromagnetické vlny, šířící se ve **výše popsaném** prostoru.“ (p. 1)

*The electric and magnetic field intensity of an electromagnetic wave propagating in the **formerly mentioned** space is found by solving the equations (3.1a, b).* (line 22)

“Nejprve přepíšeme jeho definiční vztah (3.2) **do tvaru**“ (p. 2)

*Firstly, the relation (3.2) has to be rewritten **as follows*** (line 61)

“Nyní vlnové číslo (3.6) odmocníme a **omezme se** přitom pouze **na** kladný kořen.“ (p. 2)

*Now let us extract the wavenumber (3.6) and **consider** the positive root **only**.* (line 67)

“Vlnové číslo **má** vektorový **charakter**.“ (p.5)

*The wavenumber **behaves as** a vector.* (line 134)

4.2.2 Grammatical transformation

Before the examples of grammatical transformation are given, let us specify the semicolon usage. Semicolon is referred to as a “weak full stop” or “strong comma”. The semicolon is used as Urbanová maintains: “if the sentences are stand-alone but their meaning is connected and we wish to clearly indicate such relation” (2002: 83, translated by Mičková).

There have been many grammatical transformations in the translation, only few examples are given.

4.2.2.1 Sentence fragmentation

In the following examples, the comma is substituted with the “weak full stop”.

“Velikost *vlnového vektoru* je dána vztahem (3.2), jeho směr je totožný se směrem šíření vlny.“ (p. 5)

The magnitude of a wave vector is given by eqn. (3.2); its direction is equal to the direction of wave propagation. (line 134)

“Pokud nebude dielektrikum mezi vodiči dokonalé, bude moci mezi nimi protékat příčný vodivý proud, což vyjádříme příčnou vodivostí G .“ (p. 12)

If the dielectric between the conductors is not perfect, the transverse conductive current will flow through; that is expressed by the transverse conductivity G . (line 361)

4.2.2.2 Sentence integration

In the following example, the full stop is substituted with the “strong comma”.

“Ve směrech x a y , tedy na vlnoploše, bude vzhledem k předpokládané uniformitě vlny amplituda E_x konstantní. To znamená, že všechny parciální derivace podle x a podle y budou nulové.“ (p. 2)

The amplitude E_x is constant in the direction of x and y – i.e. on the wavefront – due to the anticipated uniformity of the wave; which means that all partial derivations with respect to x and y will be equal to zero. (line 45)

4.2.2.3 Syntactic sentence compression

An example of a substitution of two subordinate clauses for a passive voice and infinitive structure follows.

“**O vlnách, které budeme analyzovat, budeme předpokládat, že jsou uniformní** – tzn. amplituda elektrické a magnetické intenzity je na vlnoploše konstantní.“ (p. 1)

The analyzed waves will be assumed to be uniformed – i.e. the amplitude of electric and magnetic intensity on the wavefront is constant. (line 7)

4.2.2.4 Part of speech replacement

An example of substitution of a noun for a pronoun follows.

“**Na této myšlence** je založena klasická teorie vedení.“ (p. 12)

*The classical transmission line theory is based **on that**. (line 354)*

4.2.2.5 Sentence elements replacement

Here is an example of a subject being shifted to object.

Na obrázku 3.3 **je znázorněna** okamžitá velikost vektorů **E** a **H** v nějakém časovém okamžiku t_0 na ose z . (p. 6)

*Fig. 3.3 **shows** the instantaneous magnitude of the vectors **E** and **H** in a time instant t_0 on the z -axis (line 173)*

An example of object being shifted to subject follows.

“**Z argumentu kosinu v (3.10) vidíme**, že časový člen ωt se od členu prostorového kz liší znaménkem.“ (p. 3)

*The **cosine argument in (3.10) shows** that the time component ωt differs from the space component kz in sign. (line 96)*

4.2.2.6 Passive and active voice replacement

An example of a substitution of an active voice for a passive voice follows.

“Relativně komplikovaným výpočtem vypočteme ze složky J_z velikost z -ové složky intenzity elektrického pole ve velké vzdálenosti od vodiče ($kr \gg 1$)“ (p. 6)

The magnitude of an electric field intensity z component far distant from the conductor ($kr \gg 1$) can be found by a relatively complex computation from the J_z component (line 191)

4.2.2.7 Multiverbal and univerbal replacement

There are no examples of multiverbal and univerbal replacement in the translation.

4.2.2.8 Word-order transformation

This is a typical example of the functional sentence perspective. In Czech, the oldest information is first – we have already discussed the *nonzero medium conductance*, followed by the new information – *wave induces currents in a medium and they are heating that medium*. In the translation however, there has been used a fixed word order – subject, verb, object, adverbial.

“V důsledku nenulové vodivosti prostředí γ v něm vlna indukuje proudy, které toto prostředí ohřívají.“ (p. 3)

The wave induces currents in a medium and they are heating that medium due to the nonzero medium conductance γ . (line 87)

4.2.3 Lexical and grammatical transformation

In this subsection, the examples of lexical and grammatical transformation are given, followed by the examples of omission and the usage of abbreviations, as these are also typical for technical style.

4.2.3.1 Antonymic translation

There is only one example of antonymic translation in the given translation:

“Navíc se omezíme na případ, kdy je námi zkoumaný prostor **prost** vnucených proudů J_{vn} a kdy je objemová hustota náboje ρ nulová.“ (p. 1)

*In addition, we will delimit ourselves to the case when there is **no presence** of impressed currents J_i in the analyzed space and the volume charge density ρ is zero.* (line 4)

The literal translation of that part of the sentence would be: *the analyzed space is **deprived of impressed currents***, on the other hand, the translator used the antonymic translation, i.e. *there is **no presence** of impressed currents*.

4.2.3.2 Amplification of a term

There has not been found any example of amplification of a term in the translation.

4.2.3.3 Periphrastic translation

There is no example of periphrastic translation, because there is no need to explain the meaning of a term in didactic technical text – it is always explained in the text.

4.2.3.4 Compensation

There is no need for compensation in technical texts in general.

4.2.3.5 Total reinterpretation

“Obklopíme-li úsek vodiče válcovou plochou o poloměru r , musí touto plochou $S = 2\pi r \Delta$ prostupovat elektrický indukční tok, který je dán právě tímto nábojem“ (p. 10)

If we surround the conductor segment with a cylindrical plane with the radius r , the electric induction flux that is given by the following charge (eqn. (4.2)) must go through the plane $S = 2\pi r \Delta$ (line 309)

The utterance above had to be reinterpreted due to the word-order transformation. In the source text, the utterance ends with a reference to the following equation. However, the word order had to be observed in the translation, which had put the reference to the following equation in the middle of the utterance. Therefore, the whole utterance must have been reinterpreted and the reference (eqn. (4.2)) had to be added.

4.2.4 **Omission and abbreviations**

The references to equations that would follow the sentence were the most frequent matters of omission, cf.:

“Jednotlivé složky vektoru magnetické intenzity jsou pak dány **vztahy**“ (p. 5)

*Individual components of the magnetic intensity vector are then given **by** (line 157)*

“Dosazením (4.16a) do (4.14b) a následnou integrací **dospějeme k výsledku**“ (p. 13)

*By substituting (4.16a) into (4.14b) and then by integrating the relation, **we get** (line 398)*

There were also other instances of omission, e.g. to avoid redundancy:

“Na základě této analogie můžeme **přímo bez dalšího odvozování** objasnit fyzikální význam vztahů (4.14)“ (p. 13)

*Based on that analogy we can **directly** explain the physical significance of equations (4.14) (line 406)*

In technical text, abbreviations play an important role. Here is an example of an English abbreviation in the source text:

“Můžeme tedy říci, že rovinná vlna ve volném prostoru je **příčně (transversálně) elektromagnetická (TEM)**.“ (p. 5)

Therefore, we can say that the plane wave in a free space is **transverse electromagnetic (TEM)**. (line 164)

The *TEM* abbreviation is commonly used in English and it is also often used in Czech. This is a typical example of a borrowing.

In the following case, the abbreviation *PEC* has been added and the term explained only in the parentheses, because the *PEC* abbreviation is in English used more often than the full term.

“Budeme předpokládat, že námi studované koaxiální vedení sestává z **dokonale elektricky vodivého** vnitřního a vnějšího vodiče.” (p. 9)

Let us assume that the TL we work with consists of **PEC** (perfect electrically conducting) inner and outer conductors. (line 278)

4.3 Technical didactic style assessment

The translation analysis has proven that terminology is the key factor in technical style. Lexical analysis has shown that over 77 % of the analyzed terminology accounted for either nouns or compound nouns. That means that the technical information is conveyed through nouns or compound nouns, thus, making the technical text semantically *dense*. Lexical transformation has shown that concretization nor generalization has not been used much in the translation; there is no room for such alterations as technical style must be *exact*. Grammatical transformations had to be applied to retain the *logical structure* and *coherence*.

Technical style as well as didactic style is *non-emotional* – it has to be, because it is used in the academic sphere. The source text and the translation are both part of a university textbook. A university textbook has to convey *unambiguous* information and it has to be *objective*. Therefore, the only parameter of technical style that has been suppressed in the favour of the didactic style is *impersonality*. Didactic style uses mainly personal phrases, such as *we will now focus on* (line 60), *let us assume* (line 278), *our further studies* (line 232). It aims at showing the student, that he is a part of the problem, which helps to increase the student's interest in the problem, thus, it is easier to take up with the problem.

5 CONCLUSION

The subject of this bachelor thesis is Commented Translation of Technical Text. The aim was to translate and analyze technical didactic text.

The first task was to find an appropriate text. Prof. Dr. Ing. Zbyněk Raida writes bilingual texts for his students to help them learn and understand the radio electronics both in Czech and English. Therefore, the translation had to resemble the structure of the source text as much as possible with great emphasis on the proper terminology translation.

This bachelor thesis has been divided into three main parts – theoretical, practical and analytical.

The theoretical part presented mainly the characteristics of technical style according to Knittlová and the properties of didactic style according to Hausenblas, as the translated text belongs to both styles. Then, the translation procedures according to Malone, and Vinay and Dabernelt were presented with the examples from the given translation, followed by translation transformations division according to Vysloužilová. Theoretical part has been concluded with the introduction of Firbas' functional sentence perspective.

The practical part has presented translation of the second chapter *Electromagnetic waves in free space* and the third chapter *Transmission lines* from the university textbook *Electromagnetic waves and antennas*.

The analytic part has been further divided into three parts – lexical analysis, translation transformation and technical didactic style assessment.

The lexical analysis presented statistics of the terminology that has been excerpted from the translation. Tab. 4-1 shows that 77.37 % of the analyzed terminology corresponded to nouns or compound nouns, which means that the technical information is mainly conveyed through these, together with adjectives (15.26 %), and the meaning of verbs is diminished, as technical verbs accounted only for 5.26 % of the analyzed terminology. Also, the compound words percentage is shown in Tab. 4-2, followed by examples for each type.

The translation transformation has been further divided into three parts – lexical transformation, grammatical transformation, and lexical and grammatical transformation. The most used lexical transformation was modulation due to the fact that English and Czech are different types of languages. On the other hand, concretization nor generalization were used much, because terminology is the key feature of technical style and, as the lexical analysis has shown, information are mainly conveyed through terms, thus, these terms should not be much alternated.

Grammatical transformations were the most used type of translation transformations. The reason is that Czech usually follows the functional sentence perspective – putting older information first and the new information at the end of the sentence, unlike English that generally follows the SVO word order (subject-verb-object). Thus, mainly word-order transformation, sentence elements replacement and passive and active voice replacement have been used. Further, the part of speech replacement and syntactic sentence compression have occurred during the translation. Due to the established usage of semicolon in English, sentence fragmentation and sentence integration have both applied the semicolon to interpret the relations between the sentences.

There were only two examples of lexical and grammatical transformations – one example of antonymic translation and one example of total reinterpretation. In the source text, one of the common features was ending the sentence with a reference to the following equation; in the translation, omission had to be used frequently and the total reinterpretation also had to be used once. Abbreviations are also a common feature of technical text, mainly in English. There was one example of English abbreviation usage in the source text and one example of adding the abbreviation in the translation, as the given abbreviation is in English used more often than the full term.

In the final assessment, it has been showed that the characteristics of the technical style according to Knittlová are in compliance with the given translation. Technical and didactic styles both share the aim to present the given topic in such a way that the reader clearly understands the subject matter. However, the impersonality of technical style is suppressed in favour of the didactic style personal approach.

6 LIST OF REFERENCES

Primary source

RAIDA, Z. (2014) *Electromagnetic waves and antennas*. Manuscript in preparation.

Publications

DUFKOVÁ, L. *Komentovaný překlad odborného textu: Železniční zabezpečovací zařízení*. 2012. Dissertation thesis. Masarykova univerzita, Filozofická fakulta. Supervisor Simona Koryčánková. Available at: <<http://theses.cz/id/no0k6k/>>: <<http://theses.cz/id/bn0acm/>>.

FIRBAS, J. *Functional sentence perspective in written and spoken communication*. Cambridge university press, 1992.

HAUSENBLAS, K. "Učební styl v soustavě stylů funkčních." *Naše řeč* vol. 55 2-3 (1972): 150. Accessed April 27, 2015 from <http://nase-rec.ujc.cas.cz/archiv.php?art=5628>.

KNITTLOVA, D. et al.: *Překlad a překládání*. Olomouc: Univerzita Palackého, 2010.

KRHUTOVA, M. *Parameters of Professional Discourse*. Brno: Tribun EU, s.r.o., 2009.

MALONE, J. L. *The science of linguistics in the art of translation: some tools from linguistics for the analysis and practice of translation*. Albany, N.Y: State University of New York Press, 1988.

MAN, O.: *Otázky ekvivalence v odborném překladu*. In: GROMOVÁ, E., HRDLIČKA, M.(red.): *Antologie teorie odborného překladu (Výběr z prací českých a slovenských autorů)*. Repronis,Ostrava 2003

MURPHY, R. *English grammar in use with answers: a self-study reference and practice book for intermediate learners of English*. Cambridge: Cambridge University Press, 2012.

URBANOVÁ, L., and OAKLAND, A. *Úvod do anglické stylistiky* . Brno: Barrister & Principal, 2002.

VINAY, and DABERNELT. *Comparative stylistics of French and English a methodology for translation*. Amsterdam Netherlands Philadelphia: J. Benjamins Pub. Co, 1995.

VYSLOUŽILOVÁ, E. *Cvičebnice překladu pro rusisty*. Olomouc: Univerzita Palackého , 2002.

Dictionaries

BOSNAK, I. *English-Czech and Czech-English dictionary of electrical engineering and electronics*. Ostrava: Montanex, a. s., 2003

Anglicko-český, česko-anglický velký slovník: nejen pro překladaatele. Brno: Lingea, 2010.

Internet resources

Online Etymology Dictionary. Available at <<http://www.etymonline.com/>>.

7 ATTACHMENTS

For the original text, please see the enclosed CD.