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KOMENTOVANÝ PŘEKLAD ODBORNÉHO TEXTU

COMMENTED TRANSLATION OF TECHNICAL TEXT

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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

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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.

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TABLE OF CONTENTS

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 univerbal units replacement – univerbal 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

ELECTROMAGNETIC WAVES IN FREE SPACE

In the whole chapter, it will be assumed that we are situated in an unlimited linear homogenous isotropic medium with the permittivity of $\varepsilon = \varepsilon_0\varepsilon_r$, permeability of $\mu = \mu_0\mu_r$ and specific conductance γ. 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. Only the presence of harmonic electromagnetic field with angular frequency ω will be considered. The analyzed waves will be assumed to be uniformed – i.e. the amplitude of electric and magnetic intensity on the wavefront is constant. The wavefront is an area where the electric and magnetic field intensity have constant phase.

The electromagnetic field that is created at a certain point of space does not fill this space in an instant but rather propagates through it in a finite speed which is dependent on the properties of the medium. 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.

Vectors **H** and **E** can be described by wave equations (2.32a, b)

$$\nabla^2\mathbf{H} + k^2\,\mathbf{H} = \mathbf{0} \tag{3.1a}$$

$$\nabla^2\mathbf{E} + k^2\,\mathbf{E} = \mathbf{0} \tag{3.1b}$$

The symbol k denotes wavenumber (2.33)

$$k^2 = -\,j\omega\mu\left(\gamma + j\omega\varepsilon\right) \tag{3.2}$$

Eqn. (3.1a, b) got their name thanks to their similarity to equations which describe the propagation of acoustic and mechanical waves. 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).

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

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

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

Plane wave propagation

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

The amplitude of the electric intensity nonzero component E_x will be changing only in the direction of propagation z; it will be decreasing due to the attenuation. 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. The vector equation (3.1b) thereby shifts to a single scalar equation

$$\frac{d^2 E_x}{dz^2} + k^2 E_x = 0 \tag{3.3}$$

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

$$E_x = A \exp(-jkz) + B \exp(+jkz) \tag{3.4a}$$

or through goniometric functions

$$E_x = A' \sin(kz) + B' \cos(kz) \tag{3.4b}$$

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

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

$$k^2 = -j\omega\mu\, j\omega\left(\varepsilon - j\gamma/\omega\right) \tag{3.5}$$

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

$$k^2 = \omega^2 \mu \tilde{\varepsilon} \tag{3.6}$$

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

$$k = k' - jk'' \tag{3.7}$$

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

$$E_x(z) = A\exp\left[-j\left(k' - jk''\right)z\right] = A\exp\left(-k''z\right)\exp\left(-jk'z\right) \tag{3.8}$$

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

$$E_x\left(z,t\right) = A\exp\left(-k''z\right)\exp\left[j\left(\omega t - k'z\right)\right] \tag{3.9}$$

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

$$E_x\left(z,t\right) = A\exp\left(-k''z\right)\cos\left(\omega t - k'z\right) \tag{3.10}$$

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

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

- The *k’* [rad.m^{-1}] symbol is so-called *phase constant*. It tells us of how many radians the phase of a wave changes on its photograph[1] at a distance z = 1 m.

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

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

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

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

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

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

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

Given that ω, *k’* and ϕ_0 are constants, the result of the indicated derivation is

$$v_f = \omega / k' \qquad (3.13)$$

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

$$\lambda = v_f T = v_f / f \qquad (3.14)$$

where f [Hz] is the wave frequency and $f = T^{1}$. This means that the phase shift 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).

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

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

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

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

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

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

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

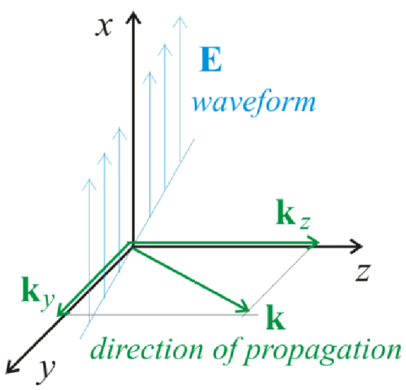

Fig. 3.1 The propagation of a plane wave in a general direction.

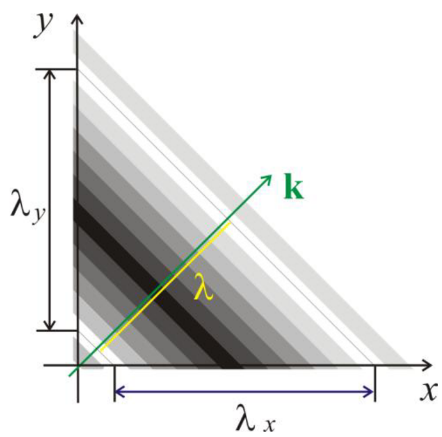

Fig. 3.2 The top view on a plane wave (maximum: black, minimum: white)

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

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

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

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

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

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

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

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

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

$$\mathbf{H} = \frac{j}{\omega \mu} \nabla \times \mathbf{E} \tag{3.21}$$

Individual components of the magnetic intensity vector are then given by

$$H_x = H_z = 0 \tag{3.22a}$$

$$H_y = \sqrt{\frac{\gamma + j\omega\varepsilon}{j\omega\mu}}\, E_x \tag{3.22b}$$

The constant of the proportionality between the electric and magnetic intensity

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

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

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

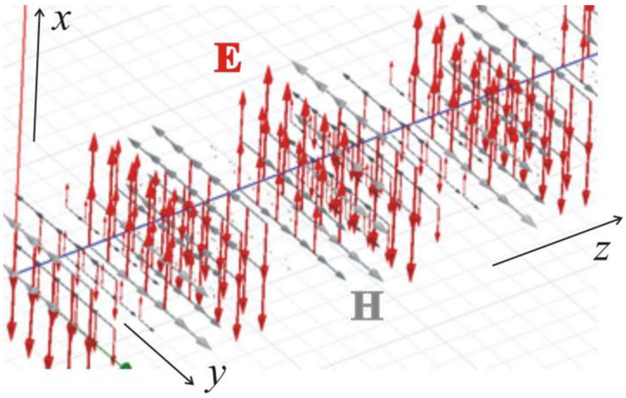

Fig. 3.3 The intensity of a plane wave in free space.

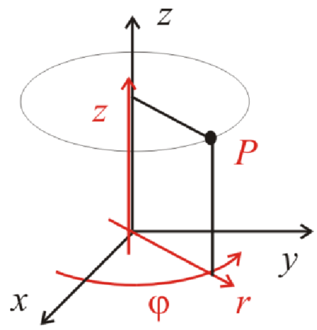

Fig. 3.4 The cylindrical coordinate system (r, φ, z).

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

Let us further mention the Poynting vector

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

The direction of Poynting vector is identical with the direction of propagation and its magnitude signifies the power density carried by an electromagnetic wave. In eqn. (3.24) the symbol × stands for the cross product and * stands for the complex conjugation of **H**[2] components.

Cylindrical wave propagation

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

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

$$E_z = C\sqrt{\frac{1}{kr}}\exp\left(-jkr\right) \tag{3.25}$$

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

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

- The term $\exp(-jkr)$ describes the travelling wave propagating radially from the conductor axis.
- The magnitude of the electric intensity amplitude E must be so high that the power passing through random cylindrical area **S,** whose longitudinal axis is identical to the source conductor, is always equal to the power radiated by the wave source P_Σ (in a lossless medium the wave energy cannot be lost).

[2] The reason for complex conjugation of vector **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*.

For a uniform wave propagating in the direction of **r** is this power far distant from the source[3] given by the relation

$$P_{\Sigma} = \Pi.\mathbf{S} = \frac{1}{2}\frac{E^2}{Z_0} 2\pi r z = const \tag{3.26}$$

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

Spherical wave propagation

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

$$E = C \exp(-jkr)/r \tag{3.27}$$

where C is the source constant.

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

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

$$P_{\Sigma} = \Pi.\mathbf{S} = \frac{1}{2}\frac{E^2}{Z_0} 4\pi r^2 = const \tag{3.28}$$

To guarantee the validity of the eqn. (3.28), the magnitude of the electric field intensity must be inversely proportional to the radial distance from the 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 **E** and **H** are perpendicular to each other and for their magnitudes apply $E/H=Z_0$.

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

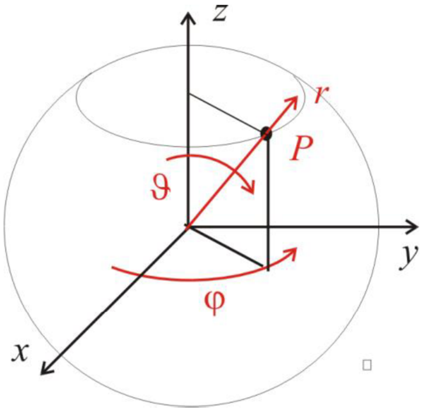

Fig. 3.5 Spherical coordinate system.

If we know the power emitted by the source P_Σ, then, after substituting (3.27) into (3.28), the source constant can be computed

$$C^2 = P_\Sigma \frac{Z_0}{2\pi} \tag{3.29}$$

Since in lossless space the wave impedance is as follows

$$Z_0 = 120\pi\sqrt{\mu_r/\varepsilon_r} \tag{3.30}$$

the eqn. (3.29) shifts to

$$C = \sqrt{60P_\Sigma}\,\sqrt[4]{\mu_r/\varepsilon_r} \tag{3.31}$$

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

$$E_{ef} = \frac{\sqrt{30P_\Sigma}}{r}\sqrt[4]{\frac{\mu_r}{\varepsilon_r}} \tag{3.32}$$

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

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

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

TRANSMISSION LINES

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

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

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

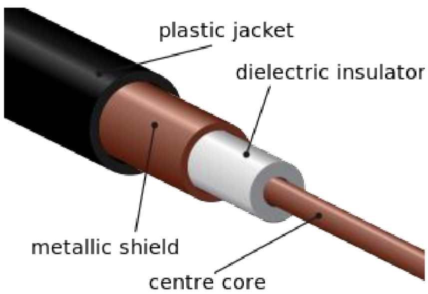

Fig. 4.1 Coaxial transmission line.
Source: http://en.wikipedia.org/wiki/coaxial_cable

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

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

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

When working with the TL, it is easier to use the scalar voltage U and current I instead of the vector field intensities **E** and **H.**

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

$$\oiint_S \mathbf{D}.d\mathbf{S} = \tau\Delta \qquad (4.1)$$

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

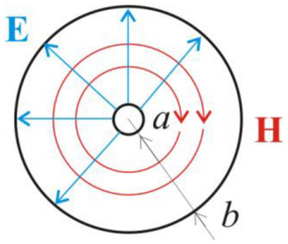

Fig. 4.2 Field distribution in the cross section of a coaxial transmission line.

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 $S = 2\pi r\,\Delta$

$$\varepsilon E 2\pi r \Delta = \tau \Delta \tag{4.2}$$

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

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

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

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

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

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

Further, we can derive from (4.3) the following

$$\frac{\tau}{2\pi\varepsilon} = E(r)r$$

and substitute it into (4.4)

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

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

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

$$\oint_l \mathbf{H}.d\mathbf{l} = I + d\psi/dt \tag{4.6}$$

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

The electric induction flux ψ through the circle area is zero because the vector of that plane **S** (in the direction of **z**) and the vector of the electric induction **D** (in the direction of **r**) are perpendicular to each other.

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

$$I = 2\pi r H \tag{4.7}$$

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

$$Z_V = \frac{U}{I} = \frac{1}{2\pi}\frac{E}{H}\ln\frac{b}{a} \tag{4.8}$$

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

$$Z_V = \frac{1}{2\pi}\sqrt{\frac{\mu}{\varepsilon}}\ln\frac{b}{a} \tag{4.9}$$

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

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

Transmission line theory

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

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

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

$$Z_1 = R_1 + j\omega L_1 \tag{4.10}$$

or

$$-dU = I\,Z_1\,dz \tag{4.11}$$

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

$$Y_1 = G_1 + j\omega C_1 \tag{4.12}$$

or

$$-dI = U\,Y_1\,dz \tag{4.13}$$

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

$$-dU/dz = I\,Z_1 \tag{4.14a}$$

$$-dI/dz = U\,Y_1 \tag{4.14b}$$

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

$$d^2U/dz^2 = U\,Z_1\,Y_1 \tag{4.15a}$$

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

$$d^2I/dz^2 = I\,Z_1\,Y_1 \tag{4.15b}$$

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

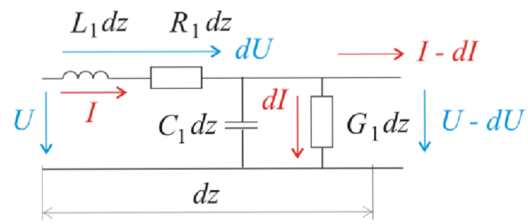

Fig. 4.3 Equivalent circuit of a two-wire transmission line.

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

$$U(z) = A\exp(-\gamma z) + B\exp(+\gamma z) \tag{4.16a}$$

where

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

is so-called propagation constant or transmission coefficient.

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

$$I(z) = \frac{1}{Z_V}\left[A\exp(-\gamma z) - B\exp(+\gamma z)\right] \tag{4.16b}$$

where

$$Z_V = \sqrt{\frac{R_1 + j\omega L_1}{G_1 + j\omega C_1}} \tag{4.18}$$

is so-called characteristic TL impedance.

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

- The term $\exp(-\gamma z)$ denotes the voltage, or current of the wave that propagates in the direction of z axis – from the source to the load. This wave is called a *forward wave* and it will be denoted by the upper index P: $U^P(z)$, $I^P(z)$. The integration constant A, or A/Z_{0V}, gives the voltage or current of a forward wave on the beginning of the TL $z = 0$.

- The term $\exp(+\gamma z)$ denotes the voltage, or current of the wave that propagates against the direction of z axis – from the load to the source. This wave is called *backward wave* or *reflected wave* and will be denoted by the upper index Z: $U^Z(z)$, $I^Z(z)$. The integration constant B, or B/Z_{0V} gives the voltage, or current of the backward wave on the beginning of the TL $z = 0$.

From the technical point of view, it is more suitable to express voltage and current according to the distance from the *end* of the TL. Voltage and current ratios on the TL are, as we are going to discover, heavily influenced by the terminating impedance 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) odmocněme 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 ($kr >> 1$)“ (p. 6)

The magnitude of an electric field intensity z component far distant from the conductor ($kr >> 1$) 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 elecronics*. Ostrava: Montanex, a. s., 2003

Anglicko-český, česko-anglický velký slovník: nejen pro překladatele. 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.