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COMPARATIVE ANALYSIS OF PROFESSIONAL TEXTS

SROVNÁVACÍ ANALÝZA ODBORNÝCH TEXTŮ

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Abstract

This Bachelor's thesis analyzes three technical texts from the field of electrical engineering. The first text chosen for this analysis is an academic textbook, the second is a technical research article, and the third is a technical lecture. All texts explain the topic of operational amplifiers. This thesis comments on the presented genres and their characteristics; however, its main focus is the analysis of cohesive chains. Types of grammatical and lexical cohesion are analyzed as well as the use of the keywords in the cohesive chains. The items of the identified cohesive chains are integrated in tables and their function in the discourse is commented on. The percentage occurrence of the individual categories of cohesion is calculated and it is implied that lexical cohesion prevails over grammatical. Some interesting distinctions arise from the comparison of the texts and the cohesive devices forming the cohesive chains.

Keywords

academic textbook, cohesion, cohesive chain, comparative analysis, genre, lecture, operational amplifiers, research article, scientific language, technology

Abstrakt

Tato bakalářská práce analyzuje tři odborné texty z oblasti elektrotechniky. Prvním textem, který byl pro tuto analýzu zvolen, je vysokoškolská učebnice, druhým je populárně naučný vědecký článek a třetím technická přednáška. Všechny texty seznamují čtenáře s tématem operačních zesilovačů. Tato práce komentuje zmíněné žánry a jejich typické znaky, avšak jejím hlavním záměrem je analýza kohezních řetězců. Analyzována je jak gramatická a lexikální koheze, tak výskyt a užití klíčových výrazů v kohezních řetězcích. Všechny položky kohezních řetězců jsou vloženy do několika tabulek a je zjištěn procentuální výskyt jednotlivých kategorií. Vychází najevo, že v každém z vybraných textů lexikální koheze značně převažuje nad gramatickou, přičemž zajímavé rozdíly jsou dány srovnáním jednotlivých textů a kohezních prostředků v nich se vyskytujících.

Klíčová slova

vysokoškolská učebnice, koheze, kohezní řetězec, srovnávací analýza, žánr, přednáška, operační zesilovače, odborný článek, odborný jazyk, technika

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Author's Declaration

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I declare that I have written this paper independently, under the guidance of the advisor and using exclusively the technical references and other sources of information cited in the project and listed in the comprehensive bibliography at the end of the project.

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Brno, May 25, 2021

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Brno, May 25, 2021

author's signature

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1. INTRODUCTION

1.1 Aim of the thesis

The aim of this Bachelor's thesis is to analyze three professional technical texts from the field of electrical engineering, and therefore specific criteria for their selection were determined in advance. The focus of this analysis are cohesive chains. I purposely chose the method of Direct cohesive chains created by Zmrzlá (2009) combined with the classification of cohesion by Halliday & Hasan (1976). A keyword was selected and monitored throughout the texts which resulted in three cohesive chains that were analyzed and compared.

For the reason of this analysis being comparative, the genres of the texts vary, and they represent both written and spoken discourse. They are an academic textbook, a technical research article, and a popular scientific lecture. Each text is expected to exhibit the typical characteristics of its genre. The genre of a research article was chosen because it is the most expanded and linguistically researched genre in this field. The language of a RA is presupposed to be simpler in comparison with an academic textbook which presents different features. The lecture, as a representative of the spoken discourse, displays many distinctions.

As already mentioned, the texts belong to the field of electrical engineering. Thus, I find it suitable to allude briefly to its discourse.

“Academic discourse refers to the use of language for the conveyance of knowledge in academic settings” (Dontcheva-Navratilova, 2012:9). In written academic discourse, the author can plan what exactly they want to write and convey in their text. They can revise their work several times so that it satisfies their intentions. Various strategies are used to make the texts understandable to the reader. In spoken discourse, the speaker has some communicative intention, and to achieve this intention and understandability “they make use not only of language but of paralanguage – tones of voice, varying stress, pauses, and so on” (Widdowson, 2007:8). According to Dontcheva-Navratilova (2012), the most important for understanding the discourse is the scope of shared disciplinary knowledge. Specifically, we talk about the knowledge of science and electrical engineering.

Discourse of science must be interpreted in a way that is understandable to the readers and listeners of this field. That is because the meaning behind every text is not only enforced by the language that people know but also by their position in society, and therefore every one of us

can perceive a given text differently. As Widdowson explains, discourse refers both to “what a text producer meant by a text and what a text means to the receiver” (2007:7).

Texts of science and technology have transactional purpose. According to Krhutová (2009b) the regular context of a text with transactional purpose are information and facts. In the field of electrical engineering, the main purpose of a piece of writing along with the register, audience and knowledge are highly important aspects that must be considered when creating a scientific work. Furthermore, when producing a text, the author must make it cohesive and coherent.

Cohesion and coherence are considered as closely related phenomena. As Dontcheva-Navratilova (2009) states, with English being the lingua franca, the concept of cohesion became fully accepted. However, coherence still lacks unanimous view from all linguists and its understanding changed a lot in the recent years. Cohesion is a textual property, while coherence “is rather seen as a property of discourse which is derived within the process of instantiation of the interpretation potential of a text” (Dontcheva-Navratilova, 2012:11 from Dontcheva-Navratilova, 2011). Coherence makes a text meaningful and according to Krhutová (2009b), it is especially related to the pragmatic meaning established in the discourse. Cohesion makes a text coherent, consistent, and perspicuous to its receivers. In order to achieve cohesion in a text, linguistically signaled connections are used. Words are linked to each other using various possibilities.

To be able to work with a text of science, and understand it fully, its readers must know the standard language and possess various skills including the knowledge of professional language. In this case, we talk about English for Electrical Engineering. As Krhutová (2009a) mentions, the field of electrical engineering evolved extremely fast and brought an enrichment to our language which resulted in the development of EEE. It is “a special branch of English for Specific Purposes” (Krhutová, 2009a:155) and its existence is vastly important for the orderly communication in science.

1.2 Contents

The Bachelor’s thesis consists of six chapters. The most important are Chapters Three to Five. These chapters first set the theoretical background and then they focus on the individual texts. Chapter Six is a conclusion of the whole thesis.

Chapter One forms an introduction. It explains the aim and purpose of this thesis and the analysis and briefly sets the theoretical background.

Chapter Two specifies the criteria for the selection of the texts. The criteria are common for all of the texts and include specifications which were set in advance and according to which the texts were searched for. The criteria include scientific language, subject matter, or genres.

Chapter Three comprises a theoretical and analytical part concerning the subject of genre and register and outlines their definitions provided by various linguists. It also specifies the characteristics of the individual genres: an academic textbook, a technical research article and a lecture; inserts and analyses extracts from each of these texts. Moreover, it encompasses the differences between popular scientific style and the style of science and technology analyzed by Krhutová (2009b).

Chapter Four sets the theoretical background of cohesion and its types which are briefly specified. The method of cohesive chain analysis is introduced and explained.

Chapter Five is the main analytical part of this thesis. It forms the most expansive and important section, in which examples of the cohesive chains and extracts of the texts are implemented. Moreover, this chapter includes various tables describing the results of the analytical process.

Chapter Six is the conclusion based on the analysis and comparison of the texts and cohesive chains identified in them.

At the end of the Bachelor's thesis can be found an extended abstract, and the lists of references and sources are provided along with the appendices containing the full forms of the cohesive chains.

2. CRITERIA FOR THE SELECTION OF TEXTS

One of the criteria for the selection of the texts for this analysis was a scientific language. Thus, I aimed to search for them at scientific websites where various genres can be found. My interest was particularly a chapter from an academic book, textbook, or encyclopedia; a research article; and a representative of a spoken genre, preferably a lecture to provide a source for comparison.

Another criterion was a common subject. I purposely chose the subject of operational amplifiers which is comprehensive, and therefore I hoped to find many instances to select from and focus my analysis on. Additionally, operational amplifiers are one of the subjects discussed in the course Analog Technology in the study program English in Electrical Engineering and Informatics on FEEC.

Furthermore, I intentionally searched for texts created by Americans, i.e., by English-speaking people using the same national standard. If texts of British and American origin were selected, there would be many distinctions to comment on. However, I decided to rather focus on different aspects of these texts.

The selected texts have the same topic but diverse genres. Different genres were chosen for the purpose of comparison of their specific signs. One of the genres is an academic textbook, which is characterized by formal language and a number of scientific terms. Although technical terms are found in all of the chosen texts, as they stem from the field of electrical engineering, formal language is not necessarily a representative of all of them. The technical RA includes informal expressions and emotive words. A lecture is a typical example of spoken academic discourse with many distinctive features. A more detailed description of the mentioned genres will be implied later.

2.1 Text 1: Operational Amplifier Internals

The first text chosen for this analysis is an academic textbook called *Operational Amplifiers & Linear Integrated Circuits: Theory and Application*. It was written by James M. Fiore, a professor of Electrical Engineering Technology from Mohawk Valley Community College. The textbook was found on *ScienceDirect*, a website with over a million of articles available to users from academic institutions and government organizations.

As its title suggest, the topic of the textbook originates in the field of electrical engineering and is exceedingly comprehensive. Six of the twelve chapters of this textbook are dedicated to

operational amplifiers. For this research I have selected only one chapter. Concretely, I have focused on the second chapter called *Operational Amplifier Internals*.

The textbook complies with the criteria for selection. It is a highly informative scientific text in which the subject of operational amplifiers is fully embodied. The aim of this textbook is to help the reader to expand their knowledge of circuit utilizing modern linear integrated circuits analysis and design. It was written for both professionals and students who already have some experience in the field of transistor circuits.

2.2 Text 2: A Practical Introduction to Operational Amplifiers

The second text chosen to be analyzed is a technical research article called *A Practical Introduction to Operational Amplifiers*. It was written by Nash Reilly, an electrical engineer from Somerville, Massachusetts. This article was posted on a technical website *allaboutcircuits.com* in a section called *Technical articles*. This website offers not only articles, but also educational videos or data sheets of electronic components.

The text is intended for beginners who want to educate themselves in the field of operational amplifiers. Therefore, I assumed there would be a distinction between such article and a chapter from an academic textbook. And the assumption was proved correct. Regarding this topic, it is obvious that scientific terms do occur; however, the language is simpler and less informative which gives me the possibility of comparison with the textbook.

2.3 Text 3: Op Amps Characteristics

The last text chosen for this analysis is an educational lecture with the title *Op Amps Characteristics*. Similarly to the second text, this lecture was found on the website called *allaboutcircuits.com* and was created by Tim Fiegenbaum at North Seattle Community College. The author provided both a video of the PowerPoint slides with his spoken commentary and the transcription of the text that he delivers during the presentation, which is exactly what I was trying to find. If only the audio had been available, it would have made it difficult to analyze the text in terms of cohesive chains and many more aspects.

The lecture is aimed at the beginners who want to educate themselves in the field of electrical engineering, or at students with some basic knowledge of this subject. I believe the language and the level of formality are appropriate to spoken discourse and this particular educational purpose.

3. GENRE AND REGISTER

The definition of genre was provided by many linguists. For example, according to Swales “genre is quite easily used to refer to a distinctive category of discourse of any type, spoken or written, with or without literary aspirations” (1990:33). Each genre has its own rules which must be followed and respected. It is how particular texts should be constructed.

Martin states that genres are realized through registers, and registers are realized through language. “Genres are how things get done when language is used to accomplish them. They range from literary to far from literary forms: poems, narratives, expositions, lectures, seminars, recipes, manuals, appointment making, service encounters, news broadcasts and so on. The term genre is used here to embrace each of the linguistically realized activity types which comprise so much of our culture” (1985:250).

Halliday & Hasan explain that “The linguistic features which are typically associated with a configuration of situational features – with particular values of field, mode and tenor – constitute a register” (1976:22). The aspects of field, tenor and mode specify the context of situation of a text. The branch of electrical engineering has its typical field, tenor and mode and its register will be different from that of any other discipline.

Register and cohesion define a text. “A text is a passage of discourse which is coherent in these two regards: it is coherent with respect to the context of situation, and therefore consistent in register; and it is coherent with respect to itself, and therefore cohesive” (Halliday & Hasan, 1976:23). These two conditions must always be complied with.

The genre and register of the individual texts will be described in the following Chapters 3.1, 3.2. and 3.3.

Popular Scientific Style vs the Style of Science and Technology

To characterize the chosen texts, let me use the explanation by Krhutová, who states that “The main criterion of distinction of the two styles is the measure of the shared specific knowledge, which is profound in the style of science and technology and rather low and superficial in the case of the popular scientific style” (2009b:53).

In the style of science and technology, terms are used very densely. The author of the given text implements special terminology and places reliance on the readers and their professional knowledge. Such specific terms are used as cohesive devices. In popular scientific style, cohesive devices may rather be formed by general words.

As Krhutová (2009b) explains, another significant difference is how explicit and implicit the texts presenting these two styles are. In general, the style of science is rather implicit and the degree of formality of this style is much higher than that of the popular scientific style which is typical by explicitness and occasionally uses rather informal, colloquial expressions in order to capture the reader's interest.

The audience of both styles differs as well. While texts of the style of science are aimed at professionals, texts of popular scientific style are also intended for general public and people who are not educated in the field of science much and thus do not understand the scientific terminology. That is the reason the authors of popular scientific texts explain everything using general language, colorful illustrations, or metaphors.

When this theory is applied to the texts chosen for this analysis, it can be stated that the academic textbook is a representative of the academic scientific prose style whereas the technical RA and the lecture are typical examples of the popular scientific style.

3.1 Text 1: Operational Amplifier Internals

"Textbooks [...] disseminate discipline-based knowledge and, at the same time, display a somewhat unequal writer-reader relationship, with the writer as the specialist and the reader as the non-initiated apprentice in the discipline, or the writer as the transmitter and the reader as the recipient of established knowledge" (Bhatia, 2004:33).

An academic textbook is a kind of manual, written by specialist, for both students of higher education and professionals. It is a teaching material which focuses on an established knowledge of a given subject determined by the curriculum and educational institutions. Its main function is explanatory and informative. Typical for academic textbooks are rather unattractive format, use of various formulas, graphs, and figures. The textbook and scientific style itself describe and explain different systems, methods, or techniques for solving a problem.

To characterize this particular academic textbook, I believe it would be best to use the words of its author:

I have tried to be direct and conversational, without being overly cute or "chatty". The body of this text is not written in a passive formal voice. It is not meant to be impersonal and cold. Instead, it is meant to sound as if someone were explaining the topics to you over your shoulder. It is intended to draw you into the topic, and to hold your attention. Over the years, I have noticed that some people feel that in order to be taken seriously, a topic must be addressed in a detached, almost antiseptic manner. While I will agree that

this mindset is crucial in order to perform a good experiment, it does not translate particularly well to textbooks, especially at the undergraduate level. The result, unfortunately, is a thorough but thoroughly unreadable book. If teachers find a text to be uninteresting, it shouldn't be surprising if the students feel the same. I hope that you will find this text to be serious, complete and engaging.

(Fiore, 2020:7)

Although this textbook may be a little bit different thanks to the author's point of view, the outline is the same as that of any other academic textbook. Each chapter includes a set of chapter objectives that lists the important items which are to be discussed. Then, each chapter comprises an introduction. Neither the introduction nor the summary with review questions at the end of each chapter will be included in this analysis. The reason is that they are not a part of a continuous text.

Furthermore, an academic textbook should be explicit, formal, and objective. It is meant to be accurate, clear, and organized, not influenced by personal emotions and feelings, and the author must choose appropriate words and figures so the reader can follow the text without any difficulties. The succeeding extract presents the typical features:

As seen in Figure 2.1, a typical op amp has at least five distinct connections; an inverting input (labeled “-”), a noninverting input (labeled “+”), an output, and positive and negative power supply inputs. These power supply connections are sometimes referred to as *supply rails*. Note that a ground connection is not directly given. Rather, a ground connection is implied through the other connections. This symbol and its associated connections are typical, but by no means absolute. There are a wide variety of devices available to the designer that offer such features as differential outputs or unipolar power supply operation. In any case, some form of triangle will be used for the schematic symbol.

(Fiore, 2020:64)

At first sight the text is full of terms from the field of electrical engineering, namely operational amplifiers. Along with scientific terms, the author uses unambiguous language. The sentences are rather concise and have a modest structure which makes the text easy to follow. To make the subject more understandable, the author incorporates explanations. Some terms are described in other words or further explained, usually in brackets. The text is formal and objective.

3.2 Text 2: A Practical Introduction to Operational Amplifiers

As mentioned above, this article was found on a website *allaboutcircuits.com* in a section called *Technical articles*. Technical article is not considered a genre itself, therefore the closest possible and most appropriate genre to assign to this article is that of a research article. A RA is universal and typical for academic discourse. There are many kinds of articles – e.g., theoretical, experimental.

This particular technical RA represents the popular scientific style and can be intended for beginners or people who want to acquire knowledge without having to read an excessive amount of information. Therefore, RAs use short words, simplified descriptions, illustrative schemata, and formulas. This is in contrast with academic textbooks. Most importantly, the writer's effort is to engage the reader. They do so by addressing them and using rhetorical questions. Moreover, contracted forms, which are rather informal, can be implemented. The author should be interested in the topic; therefore, the use of emotion is well-founded. Emotion can be illustrated by the use of an exclamation mark.

Generally, in the technical RA called *A Practical Introduction to Operational Amplifiers* the plainer language is determined by the frequent use of the word *simple*, contracted forms *isn't*, *we're*, *we'd*, *wouldn't*, or rather informal words like *bunch of*, *little*, *so*, *tedious rigamarole*, *cool*. Other examples found in the article are expressions *pretty cool*, *Huh?*, *get in the way*, *crank it up*, *let's walk through*. Such expressions are appropriate when considering the fact that this article is probably mainly aimed at students who want to get acquainted with the subject of operational amplifiers in an easy way. Also the use of phrasal verbs *swap out*, *let's see*, *go through*, *get back* suggests that the language of this text is rather informal.

The following extract from the article allows me to comment on some specific language functions:

Let's walk through this circuit's operation step by step. First, let's apply our two opamp rules to figure out *some* node voltages of this circuit. The simplest one to apply is the virtual short approximation, where V_+ and V_- are always at the same voltage. *We can see* that V_+ is tied to ground; therefore, V_- must also be at ground. What about the current going into and out of node V_- ? By Kirchhoff's current law, *we know* that the sum of all currents at that node must be as follows.

(Reilly, 2015)

As stated previously, the author frequently uses contracted forms and phrasal verbs. The use of *some* evokes vagueness and is typical example of generalization used in popular science.

Moreover, Reilly tries to engage the reader by using inclusive *we* in expressions such as *we can see, we know*. Another typical feature is the use of rhetorical questions.

3.3 Text 3: Op Amps Characteristics

Lectures are the most common form of knowledge conveyance in universities. They are delivered orally by professionals in their field who should possess great presenting skills and oriented towards the audience which varies according to the discussed course and topic. To communicate the knowledge successfully, the lecturers use many aspects which support the linguistic means, including PowerPoint slides, explanatory figures, the tone of their voice to indicate and stress the importance of some information, or gestures and facial expressions. Because the video lecture chosen for this analysis consists of the PowerPoint slides and the voice of the lecturer only, I will not be able to comment on the author's use of paralanguage.

What this lecture has in common with any other academic lecture is the outline. Firstly, an introduction is presented. Thompson explains that "Lecture introductions are significant because they offer an opportunity for the lecturer to establish an interpretative framework for the audience to use as they listen to the rest of the lecture." Based on her research, she states that lecture introductions have two main purposes: "to set up the framework" and "to establish a context for the content of the lecture" (1994:174-5). Setting up the framework gives the audience an opportunity to form an opinion about what the lecture is going to be like and putting the topic in context allows them to prepare for the new information they are going to receive.

A professor of linguistics Lee (2009) suggests one more step to be added into the introduction. According to him, the first step is "Warming Up" in which the lecturer presents information about the course, or can tell an anecdote, and the following steps are identical with those presented by Thompson (1994): "Setting Up the Lecture Framework" and "Putting the Topic in Context". In step two, the lecturer provides information about the lecture discourse, which is the same as in Thompson (1994). However, the third step is slightly different. In this step, the lecturer "establishes a context for the content of the lecturer by indicating the relevance and importance of the topic and relating it to what the audience already knows" (Lee 2009:47).

This video lecture has an introduction in which the author sets up the lecture framework and establishes a context: "We're in Chapter 11 and we'll be looking at the subjection of operational amplifiers and circuits and they're commonly referred to as "op amps" for short. We'll be looking at this particular section, 11.1, in three different section and so we're starting

out with A” (Fiegenbaum, 2007). I believe the introduction is fittingly long given the length of the whole video lecture.

Another important part every lecture should include is a conclusion in which the author sums up the most important facts that have been presented. In the chosen lecture, this necessity is fulfilled by the following sentences: “This is our introduction to op amps. We looked at schematic representation, we looked briefly at offset voltage, and we looked at some of the characteristics of an op amp” (Fiegenbaum, 2007).

This lecture presents both the written and spoken discourse. As mentioned above, we cannot see the lecturer, his posture, gestures, or facial expressions. However, this educational material has some added features. The PowerPoint slides include the key information, and the author explains the individual points in more detail. During the presentation he underlines some important words and draws example figures. Although everything he says is written under the video, the figures can only be seen in the video.

This lecture seems to be a convenient and friendly way of conveying information. Those who want to get acquainted with the topic of operational amplifiers have the main facts summed up in a video. They can hear the lecturer who uses his voice to stress the principal knowledge and to indicate the change of topic. For that purpose, he also uses conjunctions such as *and*, *and then*, or *so*. Furthermore, the author involves his audience by using inclusive *we* in expressions like *we’ll be looking at*, *as we go along*, *when we say*. He also implements utterances *you’ll see*, *you don’t need to recall*, *to be honest with you* in which he addresses the audience. To evaluate different features, let me insert a part of the text:

(Now) In some designs, the compensations pins are used to null out *this* offset voltage. *You* need to recall that...*Actually*, *you* don’t need to recall, but with op amps, the gain is typically 100,000 and *so* the tiniest voltage on the inputs can cause a rather large output and *so that’s why* sometimes they have *these* compensation pins to adjust for *that* output voltage that results.

(Fiegenbaum, 2007)

As mentioned previously, the lecturer addresses the listener using the personal pronoun *you*. Additionally, he implements colloquial expressions such as *actually*. Typical is also the use of contracted forms *don’t*, *that’s* and demonstrative pronouns *this*, *that*, *these*. Generally, the language is much simpler than that of the academic textbook and I assume it to be suitable for this purpose.

3.4 Summary

The academic textbook chosen for this analysis might be slightly different from any other academic textbook due to the author's attitude which incorporates conversational and direct approach. However, the chosen chapter is explicit, formal, and objective as expected. Fiore uses a great number of exemplary figures and formulas with descriptions, which are clearly and visibly designated in the comprehensive text. Furthermore, better lucidity of the text is achieved by bullet points. The conditions of the genre of an academic textbook are adhered to.

The second text is not a typical research article, but the genre of a RA is the most suitable option with which this technical article can be compared. This educational material uses plainer language with contracted forms and colloquial expressions. The author addresses the readers and explains everything in detail. Therefore, this text seems very appropriate for those who are not acquainted with the topic of operational amplifiers yet or possess only some basic knowledge.

The video lecture complies with some of the main characteristics of the genre of an academic lecture. It encompasses an introduction, a main part, and a conclusion. The author uses his voice to stress the key information and when moving on to another subject, he uses silence-filled pauses. Although the lecture is a one-way interaction and we cannot see the lecturer's facial expressions or gestures, I believe that for the purpose of online education and for brief delivery of the key facts, it is very suitable.

The most significant difference between the genres is the engagement of the reader. All three texts are educative and informative; however, the article and the lecture focus more on the reader by addressing them and by implementing rhetorical questions. In my opinion, this makes them seem friendlier, and therefore easier to understand and learn from. Another reason for that may be the use of informal aspects of language such as colloquial expressions or contracted forms. The academic textbook focuses on students of higher education, professionals, or professors who can use this textbook as a teaching material while the article and lecture are more suitable for those who are not properly educated in this area yet. Nevertheless, all texts comply with the characteristics of the corresponding genres and registers.

4. COHESION

Cohesion is the togetherness of grammatical and lexical units in a text. “The concept of cohesion is a semantic one; it refers to relations of meaning that exist within the text, and that define it as a text” (Halliday & Hasan, 1976:4).

Cohesion is accomplished by cohesive ties which make a text consistent. As stated by Halliday & Hasan (1976), a tie is a relation between two terms which relate to each other. These terms are called ‘the presupposing’ and ‘the presupposed’. Their function is to link the content to the context which has been established previously. An example may be an expression *electrical engineering* and term referring to *electrical engineering* is *it*. *Electrical engineering* is the presupposing term, and *it* is the presupposed. The pronoun *it* does not have any meaning unless the collocation *electrical engineering* is used before.

According to Halliday & Hasan (1976) there exists grammatical and lexical cohesion which denotes that it can be perceived through grammar or vocabulary. They distinguish five main types of cohesive ties which are: reference, substitution, ellipsis, conjunction, and lexical cohesion. Lexical cohesion comprises reiteration and collocation.

Cohesion			
Grammatical Cohesion		Lexical Cohesion	
Reference	Exophoric [situational]		Reiteration
	Endophoric [textual]		
	Anaphoric	Cataphoric	
Substitution		General word	
Ellipsis		Collocation	
Conjunction			

Table 1: Types of cohesion

Source: Adapted from Tsareva (2010:10)

4.1 Grammatical cohesion

4.1.1 Reference, substitution and ellipsis

Reference is the association between meanings. It is a type of grammatical cohesion which is used to refer to preceding or following items in the text and for that purpose it operates with three main types of pronouns, articles, or adverbs: personal, demonstrative and comparative.

As arises from its title, substitution is a cause in which one word, the presupposing, is substituted by another, the presupposed. “Substitution is a purely textual relation, with no other function than that of cohering one piece of text to another” (Halliday & Hasan, 1976:226). As they explain, substitution is a “relation in the wording rather than in the meaning” (ibid.:88), therefore the types of substitution, i.e., nominal, verbal and clausal, are given by their grammatical function.

“Ellipsis is simply ‘substitution by zero’” (ibid.:142). Although ellipsis and substitution are almost the same, it is easier to view them as separate units. Ellipsis is characterized by omitting, i.e., leaving an empty space in a clause or sentence. A word can only be omitted if the meaning of a text remains unchanged. In order to achieve understandability, a word which denotes the meaning must be present in the presupposing sentence.

4.1.2 Conjunction

Conjunction is a cohesive relation in the grammar which can connect clauses or sentences following one after another. When we consider all cohesive devices of grammatical cohesion, conjunction is the type which is the most difficult to identify directly. “Conjunctive elements are cohesive not in themselves but indirectly, by virtue of their specific meanings; they are not primarily devices for reaching out into the preceding (or following) text, but they express certain meanings which presuppose the presence of other components in the discourse” (Halliday & Hasan, 1976:226).

There exist many types of conjunctions, and due to the capacity of this thesis, the category of conjunctions will not be included in the analysis.

4.2 Lexical cohesion

Lexical cohesion is defined by Halliday & Hasan as a form involving “the repetition of a lexical item, at one end of the scale; the use of a general word to refer back to a lexical item, at the other end of the scale; and a number of things in between – the use of a synonym, near-

synonym, or superordinate” (1976:278). It is a cohesion achieved by vocabulary and comprises reiteration and collocation.

4.2.1 Reiteration

Reiteration can be achieved by repetition, synonym, superordinate, or general word or noun. Synonym is a word that has the same or nearly the same meaning as another word. Superordinate is an expression that can stand for the entire category of words. An example of superordinate to *operational amplifier* may be *an amplifier*. General noun is a cluster of nouns which are closely related. An example given by Halliday & Hasan (1976:274) is a ‘human noun’ where nouns like *people, person, man, or girl* belong. Such elements are important for making spoken language cohesive as well. As they exemplify, a general noun is almost always connected with a definite article *the*.

4.2.2 Collocation

Collocation is a pair of lexical items which together create a specific meaning. According to Halliday & Hasan (1976) every lexical item may be cohesive when properly used, but when it occurs alone, it cannot be stated whether it would work as cohesive or not.

As collocation is outside the scope of this work, no more attention will be dedicated to it.

4.3 Cohesive chains

This analysis is based on the classification of cohesion by Halliday & Hasan (1976) as was already mentioned. I included both grammatical and lexical cohesion. As for grammatical cohesion, I will analyze ellipsis, reference and substitution. The analysis of lexical cohesion comprises reiteration and its subcategories: general word, repetition, superordinate (subordinate), and synonym.

The concept of cohesive ties analysis was also inspired by Direct cohesive chains formulated by Zmrzlá. Direct cohesive chains combine two methods: “a linguistic analysis of some aspects of grammatical and lexical cohesion and a real-word context observation of the meaning of each element of the chain” (2009:41). The items of the cohesive chain are linked directly, i.e., “regardless of the category to which the links belong, whether lexical or grammatical” (2009:41).

5. ANALYTICAL PART

In this part of the Bachelor’s thesis, the three chosen texts are analyzed in terms of cohesive chains. For each text I inserted a few example sequences with the corresponding parts of the identified cohesive chains. Lexical and grammatical cohesion and their subcategories are examined and commented on with the help of various tables. The final subchapter compares these texts and presents the results of the analyses.

All the texts I have chosen for this analysis are coherent. Coherence is substantially supported by means of lexical cohesion. Because the academic textbook is more comprehensive and includes a great number of scientific terms, thus requiring professional knowledge of the reader, it has been more difficult to detect all the items creating the cohesive chain. Also, as arises from the length of the textbook, the first cohesive chain is longer than the following two.

5.1 Text 1: Operational Amplifier Internals

The keyword of the cohesive chain of Text 1 is *operational amplifier*. I selected this expression because the whole chapter is dedicated to the explanation of operational amplifiers. Therefore, I assumed that the frequency of its occurrence would be very high. Also the expression *op amp* occurs densely. I decided to view it as an equivalent to the keyword.

I did not include the Chapter Learning Objectives, Summary, and Review question into the cohesive chain analysis because they are not a part of the coherent text. For the same reason, I did not include the titles of figures and schematics. However, I incorporated the titles of the subchapters. For the sake of completeness of the cohesive chain, I decided to include expressions where the keyword is used as an attribute.

The cohesive device of ellipsis in the text is marked by symbol ∇.

An item of the cohesive chain	Lexical/ Grammatical cohesion	Cohesive device
LF411 op amp	Lexical	Subordinate
this device	Lexical	General word
The diff amp	Lexical	Subordinate

Table 2: An example of the cohesive chain

The text includes words which were quite difficult for me to categorize regarding the type of the cohesive device. An example is the sixty-third item of the cohesive chain: *LF411 op amp*. I had to resolve whether to view this expression as two individual words, which create a repetition of the keyword with specification of the keyword, or to view it as a whole representing a type of a concrete op amp. I chose the second option, and thus I determined this expression as a subordinate to the keyword. Similar expressions were settled identically.

The following item of the cohesive chain is the word *device*. Again, two possibilities of its classification in terms of cohesive devices seemed suitable. Superordinate, or general word. The word *device* could possibly be superordinate to the keyword because an operational amplifier is a type of a device. However, due to the common generic use of the expression *device*, it seemed more reasonable to classify it as a general word.

The expression on the sixty-fifth position of the cohesive chain, i.e., *diff amp* is an equivalent to another item of the cohesive chain – *differential amplifier*. Both expressions again indicate a specific type of operational amplifier, hence they belong to the category of subordinates. The shortened version implies the briefness of the scientific language.

An example of the text:

In the analysis of the cohesive chain, there were some tricky areas. To exemplify, let me cite a part of the text that describes the schematics of a type of an operational amplifier, the $\mu\text{A } 741$. “*The circuit* contains 20 active *devices* and about one dozen resistors” (Fiore, 2020:66).

In essence, Q1 and Q2 are configured as *emitter followers*, thus producing high input impedance and reasonable current gain. Q3 and Q4 are configured as *common base amplifiers*, and as such, produce a large voltage gain. The gain is maximized by the active load comprised of Q5 through Q7. The output signal at the collector of Q4 passes on to a dual transistor high-gain stage (Q16 and Q17). Q16 is configured as an *emitter follower* and buffers Q17, which is set as a *common emitter voltage amplifier*.

(Fiore, 2020:67)

The expression *the circuit* was included in the cohesive chain as it refers to the $\mu\text{A } 741$ amplifier, whose schematic model is described in this paragraph. In all three texts this expression has been classified as superordinate expression to *op amp*. The following items (only in italics), I decided not to include. Although the word *device* occurs in the cohesive chain quite often, here, the expression *devices* refers to the twenty active parts of the $\mu\text{A } 741$ amplifier, and not to the amplifier itself. Had I decided to include it, the cohesive chain would have become overly expansive and difficult to analyze. The rest of the expressions, such as *emitter follower*

or *common base amplifiers* are bipolar junction transistor amplifier topologies. They are parts of the ***μA 741*** amplifier which is a subordinate to the keyword, and they belong to a group of transistor amplifiers, not operational amplifiers, and thus were not included in the cohesive chain.

Differences in the text:

In the analyzed text can be found a few paragraphs in which there are no occurrences of the cohesive items forming the main cohesive chain. An example is a paragraph focused on the diffusion process which is the process of chip manufacturing of an op amp. The whole chapter is dedicated to the manufacture and construction. Because it explains the individual steps of the manufacturing process and describes the components needed for the production, there is no need to refer to the operational amplifier. In this concrete paragraph, no cohesive device relating to the observed cohesive chain can be found:

The process of oxidizing, masking, and diffusing will be repeated several times. The initial run will be produced with an isolation mask. This is used to separate the various components. Normally, a base mask will be used next, followed by the emitter mask. The final masks will be used for contacts and interconnections. In this way, N-type material can be placed next to, or completely within, P-type material. The adjoining areas are, of course, PN junctions. Because all circuit elements are laid out length-wise on a thin strip, this form of manufacture is referred to as a *planar* process.

(Fiore, 2020:80)

For comparison, I shall present another paragraph, where cohesive devices occur densely. The cohesive devices forming a part of the cohesive chain are marked in bold and italics:

Where might you find ***op amp circuits***? In a word, anywhere. ***They***'re probably in use in your home stereo or TV where ***they*** help capture incoming signals, in electronic musical instruments where ***they*** can be used to create and modify tones, in a camera in conjunction with a light metering system, or in medical instruments where they might be used along with various bio-sensing devices. The possibilities **▼** are almost endless.

(Fiore, 2007:64)

Although this paragraph is rather short, it comprises many cohesive devices. Namely reference and ellipsis which are representatives of grammatical cohesion. Because the subject of this paragraph is the use of op amps, it is understandable that for it to be coherent, the author must have used cohesive devices to refer to it. Because the reference is created by pronoun ***they***,

which is repeated several times, it was easy to recognize this part of the cohesive chain and follow the text.

For another comparison, let me insert a paragraph and the corresponding cohesive chain which was more challenging to detect:

An *operational amplifier* is, in essence, a *multi-stage high gain amplifier* treated as a single entity. Normally, *op amps* have a differential input and a single-ended output. In other words, one input produces an inverted output signal, and the other input produces a noninverted output signal. Often, *the op amp* is driven from a bipolar power supply (i.e., two supplies, one positive and one negative). Just about any sort of *active amplifying device* may be used for the individual stages. *Op amps* can be made entirely from vacuum tubes or discrete bipolar transistors (and of course, *they* were made that way some years ago). The advances in semiconductor manufacture in the late 1960s and early 1970s eventually made it possible to miniaturize the required components and place the whole affair on a single silicon chip (hence the term, *integrated circuit*). Through common use, *this* is what is generally meant by the term *op amp* today.

(Fiore, 2020:63)

An item of the cohesive chain	Lexical/ Grammatical cohesion	Cohesive device
An operational amplifier	Lexical	Repetition
a multi-stage high gain amplifier	Lexical	Superordinate
op amps	Lexical	Repetition
the op amp	Lexical	Repetition
active amplifying device	Lexical	General word
Op amps	Lexical	Repetition
they	Grammatical	Reference
integrated circuit	Lexical	Superordinate
this	Grammatical	Reference
op amp	Lexical	Repetition

Table 3: An example of the cohesive chain

In the whole text used for this analysis **202** items forming the cohesive chain were found. All of them have been classified and located in the table which presents the number of their

occurrences, their percentage occurrence in the cohesive chain and their percentage occurrence in the whole text. The length of the text is approximately **6200** words.

Type of cohesion	Number of occurrences	% in the cohesive chain	% in the whole text
Ellipsis ∇	11	5.45	0.18
Reference	18	8.91	0.29
Substitution	0	0	0
Grammatical cohesion	29	14.36	0.47
General word	18	8.91	0.29
Repetition	72	35.64	1.16
Superordinate/Subordinate	82	40.59	1.32
Synonym	1	0.50	0.02
Lexical cohesion	173	85.64	2.79
Total	202	100	3.26

Table 4: Cohesive devices

The cohesive chain of the academic textbook is created mainly by means of lexical cohesion and the occurrence of the devices of grammatical cohesion is approximately **six times** lower. The cohesive chain consists primarily of nouns. They are typical for the language of electrical engineering. The keyword *op amp* itself creates a major part of the cohesive chain. Besides nouns, the cohesive chain also comprises a few pronouns referring to the keyword. These pronouns represent grammatical cohesion.

Although the textbook is intended for advanced students, it still must explain the given topic, and therefore, the author endeavors to make it understandable and coherent. He is doing so by repeating the keywords very often and thus the cohesive chain is very dense. However, the chapter itself includes many descriptions and explanations, therefore the cohesive chain forms only **3.26%** of the whole text.

The first in the number of occurrences come superordinate expressions and their opposites, subordinates. This cohesive chain includes approximately the same amount of both. A superordinate to operational amplifier may be an *amplifier*. As for the subordinates, let me explain why I included the individual items. Most of the subordinates are different types of

operational amplifiers, namely *differential amplifier*, or *op amp comparator*. Differential amplifier is a circuit with two input voltages. Its output is the amplified difference between the two input values. Op amp comparator, as its name implies, compares two analogue voltage levels, and decides which is larger. The output is produced based on the larger one. What I intend to say is that these are all operational amplifiers with specific function, and therefore I classified them as subordinates to the keyword *op amp*.

Because the category of superordinate and subordinate expressions was merged in Table 4, for clarification, I prepared another table with their outline. The table shows which of the many subordinates to the keyword occur the most.

Superordinate/Subordinate	Number of occurrences	% in the cohesive chain
Amplifier	3	1.49
Circuit	39	19.31
Superordinate	42	20.79
Comparator	7	3.47
Differential amplifier	6	2.97
Diff amp	5	2.48
LF411	11	5.45
LM318	1	0.50
LM741	1	0.50
μ A 741	4	1.98
741	5	2.48
Subordinate	40	19.80
Total	82	40.59

Table 5: Occurrence of superordinates and subordinates to the keyword

The numbers of individual superordinates and subordinates are low and do not really provide much information about the cohesive chain. Low numbers of occurrence suggest that the author mentions many types of operational amplifiers but does not go into much detail. Overall, the category of superordinate and subordinates creates **40.59%** of the cohesive chain, which is quite high.

The second most supplied in the cohesive chain is the repetition of the keyword. The ratio of the occurrence of the repetition of *operational amplifier* to *op amp* is **2:70**. The shorter form of the keyword prevails. I assume it is mainly because it is rather easier to use a shorter word.

The keyword of the cohesive chain	Number of occurrences	% in the cohesive chain
Operational amplifier	2	0.99
Op amp	70	34.65

Table 6: Occurrence of the keyword

The expression *operational amplifier* which is considered the main keyword occurs as repetition in the text only **twice**. In other words, it occurs merely **three times** in the whole analyzed text. On the other hand, its shortened form *op amp* occurs **70** times, which is the main reason I considered it a keyword as well.

5.2 Text 2: A Practical Introduction to Operational Amplifiers

The word *operational amplifier* is the key expression of the cohesive chain. Other forms of the keyword are *op-amp* and *opamp*. Similarly to Text 1, I selected this keyword because the technical research article is about operational amplifiers and explains the basic principle of their use. I chose the same keyword in all of the texts to be able to provide comparison of the cohesive chains spotted in them.

In contrast with the textbook, this article does not comprise any introduction or review, therefore the whole text, apart from figure descriptions, was used for the analysis of the cohesive chain. The text consists of approximately **1420** words. For the sake of completeness of the cohesive chain, I decided to include headlines, and expressions where the keyword is used as an attribute.

As the article is much shorter than the chapter from the textbook, no paragraph without items forming cohesive chain can be found. The article explains the subject of operational amplifiers briefly without excessive information, and thus the cohesive devices are more prominent. For me, the cohesive chain was much easier to detect than in Text 1.

Again, the cohesive device of ellipsis in the text is marked by symbol **∇**.

The cohesive devices in the article are used quite alternately. In this example part of the cohesive chain, four types of cohesive devices can be observed:

An item of the cohesive chain	Lexical/ Grammatical cohesion	Cohesive device
This circuit	Lexical	Superordinate
a voltage follower	Lexical	Subordinate
it	Grammatical	Reference
an opamp	Lexical	Repetition

Table 7: An example of the cohesive chain

In the whole text there are not many sections where a single category of cohesive devices is repeated constantly. That implies that the author uses varying devices to achieve cohesion instead of repeating the keyword.

Type of cohesion	Number of occurrences	% in the cohesive chain	% in the whole text
Ellipsis √	3	3.37	0.21
Reference	15	16.85	1.06
Substitution	0	0	0
Grammatical cohesion	18	20.22	1.27
General word	2	2.25	0.14
Repetition	28	31.46	1.97
Superordinate/Subordinate	41	46.07	2.89
Synonym	0	0	0
Lexical cohesion	71	79.78	5
Total	89	100	6.27

Table 8: Cohesive devices

The cohesive chain of the technical RA is also formed mainly by means of lexical cohesion. As expected, nouns create a major part of the cohesive chain. The category of superordinates and subordinates comes first in the number of occurrences and is followed by repetition. Repetition might be the easiest to use as the author has three variants of the keyword – *operational amplifier*, *opamp*, and *op-amp*. For grammatical cohesion, the most represented is unambiguously reference. Reference is marked primarily by pronoun *it*.

This article is a representative of the popular scientific style, which is implied by explicitness. The author attempts to explain the topic of operational amplifiers for everyone to understand without difficulties. Hence, he creates a prominent cohesive chain that encompasses **89** items which is **6.27%** of the whole text. Instead of omitting some words and relying on the reader's ability to understand, he uses the means of lexical cohesion. A proof of that can be seen in the table above, i.e., ellipsis is applied only three times.

In this text, the superordinate expressions are the same as in Text 1 – *amplifier* and *circuit*. Although subordinate expressions to the keyword are different from those of the Text 1, they were included for the same reason. Here we recognize the following: *voltage follower*, *inverting amplifier*, and *noninverting amplifier*. Their functions are further explained in the article, but again, they represent the types of operational amplifiers, and hence were classified as subordinates to the keyword. The number of their occurrences is lower, but the table with their division is presented as well.

Superordinate/Subordinate	Number of occurrences	% in the cohesive chain
Amplifier	1	1.12
Circuit	23	25.84
Superordinate	24	26.97
Inverter	1	1.12
Inverting amplifier	6	6.74
Noninverting amplifier	3	3.37
Voltage amplifier	1	1.12
Voltage follower	6	6.74
Subordinate	17	19.10
Total	41	46.07

Table 9: Occurrence of superordinates and subordinates to the keyword

Prevailing in this cohesive chain are superordinate expressions. Concretely, the most occurring is the word *circuit*. As mentioned, it may be so since this article is rather general and does not go into much detail. Furthermore, the word *circuit* can refer to many items, and thus its use is much more frequent than that of any subordinate, which is merely a type of the op amp mentioned in the article.

In the RA, three variants of the keyword are used. It seemed interesting to observe how often each of these variants occurs. The numbers are presented in the following table:

The keyword of the cohesive chain	Number of occurrences	% in the cohesive chain
Operational amplifier	3	3.37
Opamp	23	25.84
Op-amp	2	2.25

Table 10: Occurrence of the keyword

The table implies that the most occurring term is once more the shortened form of the keyword, *opamp*. The shortened form is convenient to use when writing an explanatory text which must be easily comprehensible. However, it is not clear to me why the term *opamp* is used more frequently than *op-amp*. There are no sources explaining the difference between them. Perhaps the use depends only on the preference of individual authors.

5.3 Text 3: Op Amps Characteristics

The key expressions of this cohesive chain are *op amp* and *operational amplifier*, which is the same as in Text 1. The reasons for the selection of these keywords are the same as in the two previous texts. The only difference is that the shortened form *op amp* is used as the key expression first, i.e., directly in the title, and then the full version follows.

For the identification of the cohesive chain, I decided to use the spoken text, and not the text written in the PowerPoint slides. The reason for that is clear. As stated previously, my intention was to compare the written and spoken genres of academic discourse, and thus I used the text that the author communicates. The author provided the transcription of the text and placed it under the video. The transcription lacks a few of the uttered words. An example is the word *now* which can be heard in the video but is not included in the transcribed text. All these missing words are just linking expression which do not have any significant meaning in the text itself and are not important for the analysis of the cohesive chain.

This text is the shortest of all of the chosen texts. It does not include any figures or review questions and is created by approximately only **740** words. Similarly to the previous texts, headlines were included in the cohesive chain. As the text is rather simple, the identification of the cohesive chain was not overly complicated.

Once more, I decided to include expressions where the keyword is used as an attribute, and the cohesive device of ellipsis in the text is marked by symbol √.

An example of the text and corresponding cohesive chain:

Remember when we talked about a *differential amplifier*, that *it* has two inputs and on the *differential amplifier* portion *it* can have two outputs- one was inverted and one was non-inverted. Most *operational amplifiers* will only use the non-inverted output. However, there are some *op amps* out there that will actually use both. So it is not an in concrete thing that *they* only have single-ended outputs, it's just that most √ are that way.

(Fiegenbaum, 2007)

An item of the cohesive chain	Lexical/ Grammatical cohesion	Cohesive device
differential amplifier	Lexical	Subordinate
it	Grammatical	Reference
differential amplifier	Lexical	Subordinate
it	Grammatical	Reference
operational amplifiers	Lexical	Repetition
op amps	Lexical	Repetition
they	Grammatical	Reference
most √ are	Grammatical	Ellipsis

Table 11: An example of the cohesive chain

In this part of the text, four types of cohesive devices are presented – ellipsis, reference, repetition, and subordinate. The only cohesive device that does occur quite densely in the whole text but is not supplied in this example part of the cohesive chain is superordinate, which may be classified together with subordinate. Furthermore, in the whole cohesive chain can also be found one general word and one use of ellipsis, but it completely lacks substitution and reiteration achieved by synonym.

From this extract it may seem that grammatical and lexical cohesion are supplied nearly equally; however, it is not true. Prevailing is unambiguously lexical cohesion. Grammatical cohesion is achieved mostly by reference. For reference the author uses either personal pronoun

it or *they (them)* or demonstrative pronoun *this* which is used to refer to a schematic representation of an op amp implemented in the PowerPoint presentation in the video. None of the schematics are a part of the transcribed text, and therefore, without the video, the reference created by the demonstrative pronoun *this* does not make sense. For illustration of this aspect, a part of the text where the pronoun *this* is used many times is inserted. Only in three cases the demonstrative pronoun refers to the figure of op amp and thus belongs to the cohesive chain:

The 741 is a very common *op amp* and *this* is the multi-sym representation of *the 741*. We'll notice the inputs. There are inputs two and three. This would be the inverting input. This is the noninverting input, shown by the minus and the plus. Pin four is one of the power supply connections, it is for the negative power supply, and seven is for the positive power supply. Pins one and five are used for offset if they are deemed necessary to be used. They are not commonly used, to be honest with you. Pin six is the output. Down here, we just have the basic symbols showing inputs and outputs and in many *circuits*, all you'll see is *this*, they don't give you all of the detail. *This* is the schematic representation of the same *thing* from the previous page that we looked at regarding the symbol and the abbreviated symbol.

(Fiegenbaum, 2007)

All the cohesive devices forming the cohesive chain of Text 3 are again presented in the following table:

Type of cohesion	Number of occurrences	% in the cohesive chain	% in the whole text
Ellipsis ∇	1	1.96	0.14
Reference	10	19.61	1.35
Substitution	0	0	0
Grammatical cohesion	11	21.57	1.49
General word	1	1.96	0.14
Repetition	24	47.06	3.24
Superordinate/Subordinate	15	29.41	2.03
Synonym	0	0	0
Lexical cohesion	40	78.43	5.41
Total	51	100	6.89

Table 12: Cohesive devices

A substantial part of the cohesive chain of Text 3 is created by lexical cohesion. It is imparted almost **four** times more than grammatical cohesion. For both lexical and grammatical cohesion, only the most common means of achieving cohesion are supplied, namely ellipsis, reference, repetition and the category of superordinate and subordinate. Mostly used is repetition, which forms **47.06%** of the cohesive chain, and is followed by superordinate/subordinate expressions. The category of superordinates and subordinates is not as capacious as in Text 1 and Text 2, it only comprises one superordinate, i.e., *circuit*, and two subordinate expressions, i.e., *differential amplifier* and *the 741*, thus I do not find it necessary to dedicate an individual table to this category as I did with the previous texts.

Like Text 2, this lecture is explicit, and therefore a representative of the popular scientific style. It could have been expected given the fact that these two texts originate on the same website. In order to deliver an understandable text, the author created a cohesive chain of **51** items which is **6.89%** of the whole text of about **740** words. That is the highest ratio of the number of cohesive devices to the number of all words in the text that has been discovered in the three analyzed texts.

Correspondingly with the previous texts, the shortened form of the keyword is used much more densely than the full-form key expression. Here, the ratio of the full to the shortened version is **3:24**. The repetition of the short form of the keyword itself creates **47.05%** of the cohesive chain.

The keyword of the cohesive chain	Number of occurrences	% in the cohesive chain
Operational amplifier	3	5.88
Op amp	24	47.06

Table 13: Occurrence of the keyword

5.4 Comparison of the texts

The first distinction that comes to mind when comparing these three texts is their length and the length of the corresponding cohesive chains. Text 1, a chapter from an academic textbook, is about **6200** words long and its cohesive chain is formed by **202** items. That implies that the cohesive chain creates only **3.26%** of the text, while the cohesive chain of the article forms **6.27%**. That is almost two times higher value. Text 2 may be only **1420** words long, but its cohesive chain comprises many items. Perhaps it is because, as mentioned, the author tries to

make the text easily understandable and instead of omitting, he repeats. Text 3 is the shortest one. It consists of approximately **740** words and its cohesive chain includes **51** items. That indicates that the cohesive chain forms **6.89%** of the text which is the highest value when compared to the two remaining texts. The ratio of the length of each cohesive chain and the corresponding text is presented in Figures 1, 2 and 3.

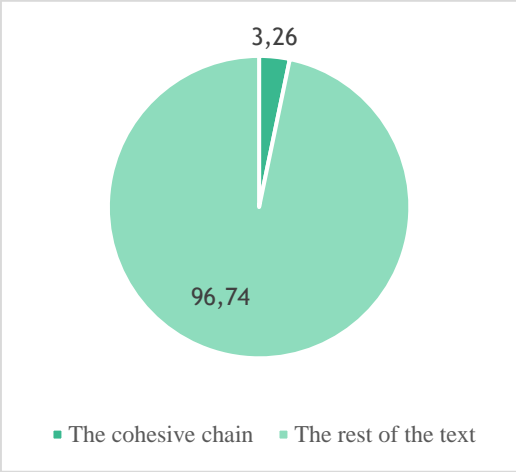


Figure 1: The occurrence of the cohesive chain in Text 1 (%)

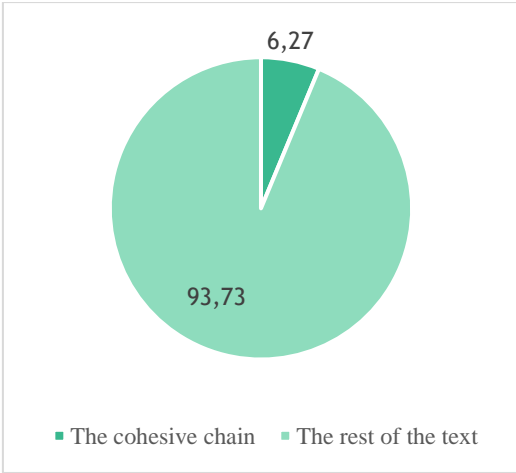


Figure 2: The occurrence of the cohesive chain in Text 2 (%)

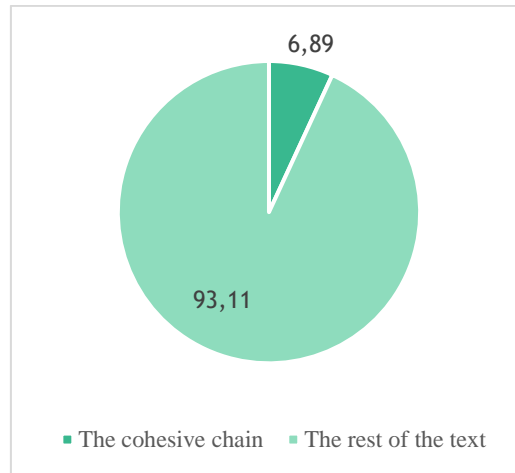


Figure 3: The occurrence of the cohesive chain in Text 3 (%)

Although Texts 1 and 2 represent the written discourse, and Text 3 the spoken one, there are not many significant differences apart from the fact that in Text 3, we can hear the lecturer explaining the topic. The main body of the spoken text is based on the written notes in the PowerPoint slides; therefore, the author has an outline that he follows. He uses some silence-filled pauses when changing the topic, sometimes false starts can be noticed, but overall, not many features of the spoken discourse can be observed.

Equivalents to the keyword:

Each text uses some shortened form of the keyword *operational amplifier*. The academic textbook and the lecture use only one shortened form, i.e., *op amp*, while the author of the technical research article suggests two possibilities, i.e., *opamp* and *op-amp*. The option found in the textbook and the lecture is formed by two items, *op* and *amp*. Out of the three possibilities, I find this version the most appropriate to the expression *operational amplifier*, which also consist of two items, with the difference that in *op amp* each of these items is shortened. However, the expression *op-amp* is used frequently as well.

To make the use of shortened forms clearer, I decided to look them up in an online search engine *google.com*, known to all internet users. In just a few tenths of seconds, *google.com* presented the following numbers:

Equivalents to the keyword	Number of results generated by google.com
Operational Amplifier	51 200 000
Op amp	150 000 000
Op-amp	148 000 000
Opamp	39 100 000

Table 14: Equivalents to the keyword

The numbers are of course changing every second, and therefore these results and their analysis are only approximate. When I inputted the expression *operational amplifier* into the lookup table, 51 200 000 results were displayed. This expression may be superordinate to the shortened versions, however when I searched for one of the short forms *op amp* or *op-amp*, the number of results was much higher. The only exception was with the shortened form *opamp*, whose number of search results was lower. I discovered that when searching for any of these expressions, the search engine also displays texts including any of the other forms of the keyword. To further explain – when I inputted the term *op amp* into the search engine, it displayed texts with the other three variants of the keyword as well.

I attempted to find some explanation of the differences. However, it seems there are neither any differences, nor any rules for the use of these expressions. Hence, I assume, that all forms are equal, and their selection depends on the individual author and their preference.

In all texts, lexical cohesion prevails over the grammatical. In the first cohesive chain, the ratio of grammatical to lexical cohesion is approximately **1:6**, in the second cohesive chain it is **1:4**, and in the third also almost **1:4**. This suggest that all authors have used more nouns to create the cohesive chain rather than properties of grammatical cohesion. Overall, the types of grammatical cohesion, namely ellipsis and substitution, are more challenging to detect than the types of lexical cohesion. The most supplied in the cohesive chain of Texts 1 and 2 are superordinate and subordinate expressions to the keyword. In second place comes repetition, which for me was the easiest to determine. In Text 3, it is the opposite. Repetition occurs the most, and superordinate and subordinate expressions follow. The percentage ratio of the occurrence of grammatical and lexical cohesion in each text is presented in the following figures:

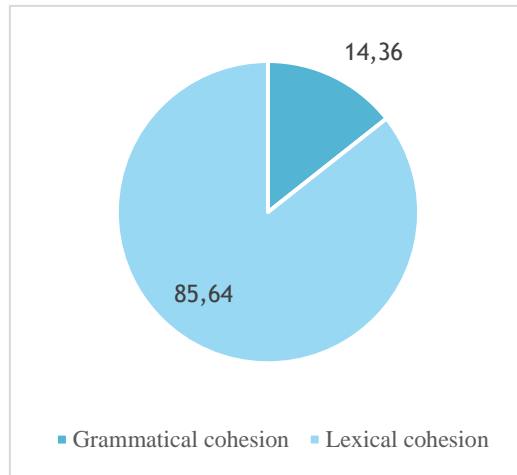


Figure 4: The ratio of grammatical and lexical cohesion in the cohesive chain of Text 1 (%)

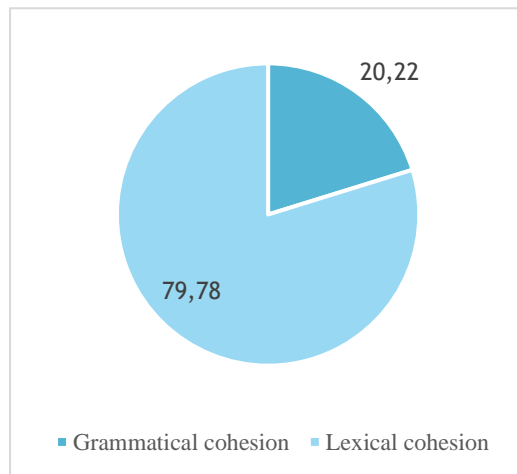


Figure 5: The ratio of grammatical and lexical cohesion in the cohesive chain of Text 2 (%)

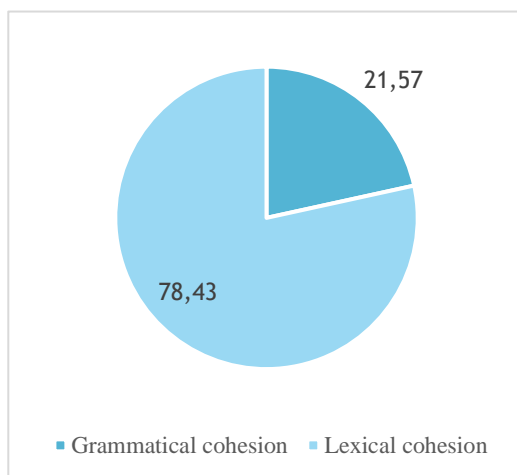


Figure 6: The ratio of grammatical and lexical cohesion in the cohesive chain of Text 3 (%)

The individual cohesive devices are the most engaged in Text 1. That also applies for ellipsis. It may be this way because the language of the academic textbook is more complex than that of the technical research article or a short lecture. The use of ellipsis demands the reader's attention and excellent orientation in the text. Although ellipsis is not difficult to understand when reading a comprehensive text, it is quite challenging to detect when searched for. In other words, the detection of ellipsis requires the reader or analyst to be alert and thoughtful.

Another difference in the use of the cohesive devices is the ratio of substitution and synonym. The occurrence of substitution in all texts is zero. One synonym to the keyword is used in the cohesive chain of Text 1. In the case of substitution, I believe that zero occurrence of this type of grammatical cohesion is due to its rare use. Synonym, on the other hand, could occur densely, have I decided to approach some of the items of the cohesive chains differently. In Text 1 and 3, I classified the expression *op amp* as an equivalent to the keyword *operational amplifier*. In Text 2, I did the same with the other variants *op-amp* and *opamp*. And hence, all these expressions were marked as repetition. I could have classified them as synonyms to the keyword and the percentage occurrence would be different. However, to view them as equivalents seemed more appropriate.

6. CONCLUSIONS

For this comparative analysis, I used texts which were found on the Internet. The sources of all three texts are technical websites providing miscellaneous materials for education. One of them is a website called *sciencedirect.com* where the textbook was found. This website offers books, encyclopedias, or journals from various fields of science, including Engineering, Health, or Physical Sciences and allows the internet users to get acquainted with many different fields of studies. The other website *allaboutcircuits.com*, which is the source of the two remaining texts, only focuses on circuitry. Its main content are articles, videos, or podcasts.

The common topic of the analyzed texts are operational amplifiers. I set the criteria for the selection of the texts in advance. Out of many possibilities, a chapter from an academic textbook and technical research article complied with these criteria the best and thus were chosen as the representatives of the written discourse. For the spoken text, it seemed suitable to choose a lecture as the subject of operational amplifiers is close to the academic environment and education. Some of the other criteria, such as diverse genres, or the origin of the authors were satisfied as well.

Typical for all these texts on the topic of op amps is scientific language and suitable register. All texts represent the characteristic features of the corresponding genres. Similarities in the texts can be found in the use of exemplary figures and formulas, terms from the field of electrical engineering, and rather friendly approach. Concerning the written texts, the academic textbook is more professional, and goes into more detail. The difference is enhanced by the degree of formality of the language. While the textbook displays very formal language, the article is characterized by informality and colloquial expressions. Furthermore, the article seems to try to engage the reader much more, and thus the author uses simpler explanations. These properties are characteristics of the popular scientific style and the style of science and technology as presented by Krhutová (2009b). The lecture is very similar to the technical RA considering language. Even though Text 3 is spoken, its fundament is the written in the PowerPoint slides which the lecturer follows, and thus the main difference is the fact that we can hear the lecturer which may be more comfortable for some students. Both Reilly (2015) and Fiegenbaum (2007) use colloquial expressions and personal approach to the reader, and in the case of Text 3, the listener.

Distinctive are also the lengths of the texts. The textbook consists of 589 pages, hence a chapter of 22 pages was selected and with the elimination of a few parts of the text, i.e., the

summary, or review questions, the text used for this analysis is formed by approximately **6200** words. Text 2 is only **1420** words long. However, the percentage occurrence of the cohesive chain in the whole article is almost **two times** higher than that of the academic textbook. That can also be stated about the cohesive chain of the lecture, which is the shortest of all of the texts and is approximately only **740** words long. However, the percentage occurrence of the cohesive chain in Text 3 is the highest, i.e., **6.89%**. I believe the length of the cohesive chains is appropriate to the length of the texts.

The method of the cohesive chain analysis was based on the classification of cohesive chains provided by Halliday & Hasan (1976) and the concept of Direct cohesive chains by Zmrzlá (2009). Because the academic textbook explains everything in detail and presents many figures and formulas including their descriptions, the cohesive chain was more challenging to detect than in the case of the technical RA and lecture which use simpler language. After analyzing each text, it has been ascertained that all cohesive chains are predominantly created by means of lexical cohesion. In Text 1, lexical cohesion is applied approximately **six times more** than grammatical cohesion. In Text 2, the ratio of grammatical to lexical cohesion occurrence is **one to four**, and in the third text, the ratio is also close-to **one to four**.

For lucidity and clarification, all types of cohesive devices have been placed in tables and their percentage occurrence in the cohesive chains and in the whole texts has been calculated. In the first two cohesive chains the most numerous category is that of superordinate/subordinate expressions. However, when this category is split into two individual ones, i.e., superordinate and subordinates, the most applied is repetition. Repetition is also the most expansive in Text 3, in which superordinate and subordinates come in second. In my opinion, repetition is the easiest option of achieving cohesion. Apart from the main table, the cohesive chains have been commented on using figures and tables concerning specific areas of the analysis.

One of the interesting parts of this analysis is the use of the keyword. In the texts, altogether four possibilities for the denotation of operational amplifiers were used. The terms are the following: *operational amplifier*, *op amp*, *op-amp*, and *opamp*. They all refer to the same object. When searching for them, approximately the same results, i.e., similar texts, are displayed. Therefore, all these expressions were viewed as equivalent in this analysis of the cohesive chains. In the commentary I preferably used the term *op amp* which is short and cogent.

To conclude, the selected texts were found suitable for this analysis and, furthermore, I believe they are suitable for the study of operational amplifiers on their respective distinctive levels. The academic textbook should be preferred by advanced students or teachers, while the

technical RA and the lecture are appropriate for the students who want to acquire basic knowledge in an easier, faster, and perhaps a more friendly way. All texts are cohesive and coherent. Cohesion is achieved by means of grammatical and lexical cohesion and their main categories. The cohesive chains comprise many words related to operational amplifiers, such as their types. Therefore, the most applied categories of lexical reiteration are superordinate and repetition. In general, lexical cohesion is frequently considered more suitable for the field of electrical engineering and science than grammatical cohesion and the results of this thesis confirm the general tendency.

EXTENDED ABSTRACT/ ROZŠÍŘENÝ ABSTRAKT

Tato bakalářská práce se zabývá analýzou kohezních řetězců tří odborných textů z oblasti elektrotechniky. Prvním textem, který byl pro tuto analýzu zvolen, je kapitola z vysokoškolské učebnice, druhým je populárně naučný vědecký článek a třetím technická přednáška. Vysokoškolská učebnice pochází z webové stránky *sciencedirect.com* a tvoří neobsáhlejší celek. Jejím autorem je James M. Fiore, profesor univerzity Community College v Mohawk Valley. Samotná učebnice je 589 stran dlouhá, nicméně pro tuto analýzu byla zvolena pouze kapitola o délce 22 stran. Zbylé dva texty byly nalezeny na portálu *allaboutcircuits.com*. Populárně naučný článek vytvořil technik Nash Reilly a přednášku připravil Tim Fiegenbaum na univerzitě North Seattle Community College. Texty byly vybrány na základě předem stanovených kritérií. Mezi tato kritéria patří například společné téma, odborný jazyk a výskyt terminologie typické pro elektrotechniku. Všichni zmínění autoři používají americký standard anglického jazyka.

Záměrně byly zvoleny dva texty, které zastupují psaný akademický diskurz, tj. vysokoškolská učebnice a populárně naučný vědecký článek, a jeden příklad diskurzu mluveného, tj. populárně naučná přednáška. Typickým znakům těchto žánrů a definici žánru jako takového se věnuje třetí kapitola. V ní je obsažen teoretický úvod a ukázky jednotlivých textů, na nichž jsou rozebírány charakteristiky žánrů, jazyk, úroveň formality, i postoj autorů jednotlivých textů ke čtenářům a posluchačům. Ten se liší i přesto, že texty mají společné téma operačních zesilovačů, které se snaží svému publiku vysvětlit a přiblížit. Zatímco učebnice může být určena nejen studentům s pokročilou znalostí operačních zesilovačů, ale i odborníkům, zbylé dva texty jsou veřejně přístupné komukoliv, kdo se s touto oblastí elektrotechniky chce seznámit. Tomu odpovídá i míra odbornosti textů, jež je vyznačena stylem odborným a populárně naučným. Konkrétní příklady těchto rozdílů jsou zdůrazněny v úryvku každého z textů a patří mezi ně například užívání hovorových výrazů, oslovení publika, či výskyt řečnických otázek.

Jak již bylo zmíněno, hlavním záměrem této práce je analýza kohezních řetězců. Teoretický úvod ke kohezi a její kategorie jsou představeny ve čtvrté kapitole společně s metodou analýzy kohezních řetězců, která kombinuje klasifikaci koheze podle autorů Halliday & Hasan (1976) s metodou Zmrzlé (2009) zvanou "Direct cohesive chains". Halliday & Hasan (1976) rozlišují pět hlavních kategorií koheze: reference, substituce, elipsa, konjunkce a lexikální koheze.

Postup “Direct cohesive chains“ spojuje jednotlivé členy kohezních řetězců nezávisle na tom, do jaké kategorie koheze, zda gramatické či lexikální, náleží.

Postup analýzy je u všech kohezních řetězců identický. Nejprve je zvoleno klíčové slovo *operational amplifier*, které mají všechny texty společné. Každý z textů dále používá zkrácené formy tohoto klíčového výrazu. V prvním a třetím textu se vyskytuje verze *op amp*, ve druhém jsou možnosti dvě: *op-amp* a *opamp*. Všechny tyto pojmy označují operační zesilovač, a proto byly vyhodnoceny jako pojmy ekvivalentní. Poté jsou v textu vyhledávány výrazy, jež na klíčový termín odkazují. Mezi tyto výrazy patří i slovní spojení, ve kterých je výraz *operational amplifier* užit jako atribut. Následně je určeno, do jaké kategorie koheze, gramatické či lexikální, tyto pojmy formující kohezní řetězce patří.

Pro co největší podobnost podmínek pro analýzu byly některé části textů vynechány. Například kontrolní otázky na konci kapitoly z učebnice nejsou součástí souvislého textu o operačních zesilovačích, a proto nebyly do analýzy zahrnuty. Z obdobného důvodu byly vynechány i popisky schémat a tabulek.

Správná identifikace kohezních řetězců a schopnost orientovat se v textech je podmíněná znalostí odborného anglického jazyka a terminologie typické pro oblast elektrotechniky. Ve zvolených textech bylo nutné se nad některými pojmy kohezních řetězců pozastavit a správně rozhodnout o jejich klasifikaci. Příkladem je pojem *device*, který lze vnímat jako výraz nadřazený, tj. superordinate, ke klíčovému výrazu, a to proto, že operační zesilovač je typem elektrotechnického zařízení. Nicméně, výraz *device* je v textech užíván velmi obecně, a z toho důvodu jsem se rozhodla ho klasifikovat jako pojem obecný, tj. general word. V každém z textů jsou popisovány různé typy operačních zesilovačů, např. komparátor, či napěťový sledovač, které byly přiřazeny do kategorie podřazených pojmů, tj. subordinate. Tyto a další podobná odůvodnění klasifikace jsou v práci prezentována spolu s ukázkovými částmi textů či korespondujícími úryvky kohezních řetězců. Jelikož jsou kohezní řetězce velmi obsáhlé, v plném rozsahu jsou dodány v příloze.

Výskyt všech členů kohezních řetězců je prezentován v několika tabulkách, ve kterých jsou dané členy rozřazeny podle kategorie gramatické či lexikální koheze, již zastupují. Tabulky rovněž ukazují procentuální podíl jednotlivých kategorií v odpovídajících řetězcích a v textech samotných. Nejčtenější podíl všech kategorií koheze má kapitola z vysokoškolské učebnice, jejíž obsah je několikanásobně vyšší než obsah dvou zbylých textů. Procentuální výskyt jednotlivých kategorií vypovídá o tom, že nejzastoupenější je repetice a následují výrazy

nadřazené a podřazené. Naopak, v žádném z kohezních řetězců se nevyskytuje substituce. A to nejspíše proto, že její užití není v lexikálně velmi obsáhlých odborných textech příliš časté.

Délka textů je pouze jednou z několika odlišností. Hlavním rozdílem je, že v případě třetího textu lze slyšet mluvený výklad, jenž může být preferovaný řadou studentů proto, že dodává pocit blízkosti a osobnějšího vztahu přednášejícího a posluchače. Zároveň je výklad přehlednější a stručnější, tedy pro předání základních informací velmi vhodný. Nicméně pro rozšíření znalostí je téměř nevyhnutelné začít se do delšího, více informativního textu, jímž je právě vysokoškolská učebnice.

Jednou ze zajímavostí je forma klíčového slova *operational amplifier*. Jak již bylo zmíněno, v každém z textů se vyskytují alespoň dvě varianty tohoto výrazu. Čísla jejich výskytu vygenerovaná světoznámým prohlížečem *google.com* jsou zapsána do tabulky, avšak pravidla užití těchto výrazů nejsou známa. S největší pravděpodobností volba formy výrazu závisí na preferenci autora.

Ačkoliv je ze všech vybraných textů kapitola z vysokoškolské učebnice nejobsáhlejším celkem tvořeným přibližně **6200** slovy, její kohezní řetězec formuje pouze **3,26 %**. V druhém textu o **1420** slovech kohezní řetězec zastupuje **6,27 %** celku, a ve třetím textu o délce **740** slov tvoří kohezní řetězec **6,89 %**. I přesto, že je třetí text nejkratší, obsahuje procentuálně největší podíl kohezních prostředků tvořících kohezní řetězec. Důvodem pro to může být fakt, že tento text se snaží předat nejpodstatnější informace velmi stručně, a nezachází do podrobnějších souvisejících témat, což může být řečeno i o textu druhém. Naopak text první je velmi obsáhlý. V takovém kvantu informací není výskyt výrazů tvořících kohezní řetězec příliš frekventovaný, a tudíž je kohezní řetězec obtížnější identifikovat.

Ve všech vybraných textech lexikální koheze značně převažuje nad gramatickou, a to primárně z důvodu velmi četného výskytu terminologie. Poměr gramatické a lexikální koheze v určených kohezních řetězcích je v případě prvního textu **1:6**, v textu druhém **1:4** a v textu třetím taktéž téměř **1:4**.

V závěru byly všechny texty zvolené pro tuto analýzu shledány jako vhodné materiály pro studium operačních zesilovačů na patričních úrovních. Zároveň splňují podmínky odpovídajících žánrů a registrů a jsou vhodné pro srovnání a poukázání na hlavní rozdíly a odlišnosti.

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SYMBOLS AND ABBREVIATIONS

Abbreviations:

EEE	English for Electrical Engineering
FEEC	Faculty of Electrical Engineering and Communications
RA	Research Article

Symbols:

∇	ellipsis
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LIST OF APPENDICES

Appendix A - Text 155
Appendix B - Text 261
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LIST OF ATTACHMENTS

Text 1: Operational Amplifier Internals

Text 2: A Practical Introduction to Operational Amplifiers

Text 3: Op Amps Characteristics

Appendix A - Text 1

Item of the cohesive chain	Lexical/ Grammatical cohesion	Cohesive device
Operational Amplifier Internals		
1. the operational amplifier	Lexical	Repetition
2. op amp	Lexical	Repetition
3. as it is commonly known	Grammatical	Reference
4. general-purpose op amp	Lexical	Repetition
5. internal circuits	Lexical	Superordinate
6. an initial op amp data sheet	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
7. the first op amp circuit examples	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
8. an op amp	Lexical	Repetition
9. it	Grammatical	Reference
10. it	Grammatical	Reference
11. application circuit design	Lexical	Superordinate
12. An Op Amp	Lexical	Repetition
13. An operational amplifier	Lexical	Repetition
14. a multi-stage high gain amplifier	Lexical	Superordinate
15. op amps	Lexical	Repetition
16. the op amp	Lexical	Repetition
17. active amplifying device	Lexical	General word
18. Op amps	Lexical	Repetition
19. they	Grammatical	Reference
20. integrated circuit	Lexical	Superordinate
21. this	Grammatical	Reference
22. op amp	Lexical	Repetition
23. a typical op amp	Lexical	Repetition
24. devices	Lexical	General word
25. op amps	Lexical	Repetition
26. general-purpose building blocks	Lexical	General word
27. With them	Grammatical	Reference
28. useful circuits	Lexical	Superordinate
29. op amps	Lexical	Repetition
30. op amps	Lexical	Repetition
31. discrete circuit designs	Lexical	Superordinate
32. a given circuit	Lexical	Superordinate
33. op amps	Lexical	Repetition

34.	op amps	Lexical	Repetition
35.	op amps	Lexical	Repetition
36.	a circuit	Lexical	Superordinate
37.	op amps	Lexical	Repetition
38.	op amp circuits	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
39.	They ´re	Grammatical	Reference
40.	they help	Grammatical	Reference
41.	they can	Grammatical	Reference
42.	they might	Grammatical	Reference
43.	The possibilities ▼ (of their usage)	Grammatical	Ellipsis
44.	An Op Amp	Lexical	Repetition
45.	the op amp	Lexical	Repetition
46.	The generic op amp	Lexical	Repetition
47.	A real op amp	Lexical	Repetition
48.	but ▼ can	Grammatical	Ellipsis
49.	the op amp	Lexical	Repetition
50.	a differential amplifier	Lexical	Subordinate
51.	differential amplifier	Lexical	Subordinate
52.	the op amp ´s AC characteristics	Lexical	Repetition
53.	the entire circuit	Lexical	Superordinate
54.	the op amp	Lexical	Repetition
55.	a real world circuit	Lexical	Superordinate
56.	the differential amplifier	Lexical	Subordinate
57.	discrete circuit	Lexical	Superordinate
58.	device matching abilities	Lexical	General word
59.	circuit gain	Lexical	Superordinate
60.	integrated op amp	Lexical	Repetition
61.	Due to ▼ size limitations	Grammatical	Ellipsis
62.	these circuits	Lexical	Superordinate
63.	A simplified equivalent circuit	Lexical	Superordinate
64.	LF411 op amp	Lexical	Subordinate
65.	this device	Lexical	General word
66.	the diff amp	Lexical	Subordinate
67.	The diff amp	Lexical	Subordinate
68.	op amps	Lexical	Repetition
69.	the 741	Lexical	Subordinate
70.	this device	Lexical	General word
71.	it	Grammatical	Reference

72.	it	Grammatical	Reference
73.	it	Grammatical	Reference
74.	the μA 741	Lexical	Subordinate
75.	the 741	Lexical	Subordinate
76.	this version ▼	Grammatical	Ellipsis
77.	and ▼ may be	Grammatical	Ellipsis
78.	a 741	Lexical	Subordinate
79.	the circuit	Lexical	Superordinate
80.	this circuit	Lexical	Superordinate
81.	circuit blocks	Lexical	Superordinate
82.	the differential amplifier	Lexical	Subordinate
83.	The diff amp	Lexical	Subordinate
84.	this circuit	Lexical	Superordinate
85.	op amp	Lexical	Repetition
86.	A differential amplifier	Lexical	Subordinate
87.	op amp 's internal structure	Lexical	Repetition
88.	the device	Lexical	General word
89.	multistage op amp	Lexical	Repetition
90.	typical op amps	Lexical	Repetition
91.	A Simple Op Amp simulation model	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
92.	op amp	Lexical	Repetition
93.	the model ▼ is	Grammatical	Ellipsis
94.	the op amp	Lexical	Repetition
95.	an op amp	Lexical	Repetition
96.	the op amp	Lexical	Repetition
97.	the op amp	Lexical	Repetition
98.	the circuit model	Lexical	Superordinate
99.	op amps	Lexical	Repetition
100.	circuit stimulation	Lexical	Superordinate
101.	a circuit	Lexical	Superordinate
102.	the same circuit	Lexical	Superordinate
103.	Op Amp Data Sheet	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
104.	the 741	Lexical	Subordinate
105.	the LM741	Lexical	Subordinate
106.	the μA741	Lexical	Subordinate
107.	the 741	Lexical	Subordinate
108.	μA741	Lexical	Subordinate

109.	this op amp	Lexical	Repetition
110.	the μA741	Lexical	Subordinate
111.	the commercial grade device	Lexical	General word
112.	the LM318 commercial grade op amp	Lexical	Subordinate
113.	the LF411 op amp	Lexical	Subordinate
114.	modern op amp	Lexical	Repetition
115.	the device	Lexical	General word
116.	the LF411	Lexical	Subordinate
117.	The op amp	Lexical	Repetition
118.	it	Grammatical	Reference
119.	general purpose op amps	Lexical	Repetition
120.	the LF411	Lexical	Subordinate
121.	op amps	Lexical	Repetition
122.	this	Grammatical	Reference
123.	device	Lexical	General word
124.	the device	Lexical	General word
125.	the LF411	Lexical	Subordinate
126.	the op amp	Lexical	Repetition
127.	the device	Lexical	General word
128.	the op amp	Lexical	Repetition
129.	the input differential amplifier stage	Lexical	Subordinate
130.	the LF411	Lexical	Subordinate
131.	a JFET diff amp	Lexical	Subordinate
132.	a typical LF411	Lexical	Subordinate
133.	LF411	Lexical	Subordinate
134.	Op amps	Lexical	Repetition
135.	average device	Lexical	General word
136.	the op amp	Lexical	Repetition
137.	its	Grammatical	Reference
138.	the typical device	Lexical	General word
139.	the op amp	Lexical	Repetition
140.	the op amp	Lexical	Repetition
141.	When ∇ producing	Grammatical	Ellipsis
142.	the op amp	Lexical	Repetition
143.	device parameters	Lexical	General word
144.	the op amp 's performance	Lexical	Repetition
145.	typical circuits	Lexical	Superordinate
146.	Simple Op Amp Comparator	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute

147.	an op amp	Lexical	Repetition
148.	some typical parameters ∇	Grammatical	Ellipsis
149.	an application ∇	Grammatical	Ellipsis
150.	op amp	Lexical	Repetition
151.	The typical LF411	Lexical	Subordinate
152.	an op amp	Lexical	Repetition
153.	and ∇ is driving	Grammatical	Ellipsis
154.	the op amp 's gain	Lexical	Repetition
155.	The op amp	Lexical	Repetition
156.	The LF411 op amp	Lexical	Subordinate
157.	the diff amp stage	Lexical	Subordinate
158.	this amplifier	Lexical	Synonym created by the combination of superordinate expression and grammatical cohesion type reference 'this'
159.	it	Grammatical	Reference
160.	amplifiers	Lexical	Superordinate
161.	op amp circuit	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
162.	a comparator	Lexical	Subordinate
163.	A comparator	Lexical	Subordinate
164.	A comparator	Lexical	Subordinate
165.	this circuit	Lexical	Superordinate
166.	the op amp	Lexical	Repetition
167.	the LF411	Lexical	Subordinate
168.	the comparator 's output	Lexical	Subordinate
169.	the comparator 's output	Lexical	Subordinate
170.	A real world circuit	Lexical	Superordinate
171.	an inverse circuit	Lexical	Superordinate
172.	Circuits	Lexical	Superordinate
173.	Comparators	Lexical	Subordinate
174.	the comparator	Lexical	Subordinate
175.	op amp comparator	Lexical	Repetition
176.	a typical op amp	Lexical	Repetition
177.	its	Grammatical	Reference
178.	logic circuits	Lexical	Superordinate
179.	limiting circuitry	Lexical	Superordinate
180.	a number of circuits	Lexical	Superordinate
181.	Op Amp	Lexical	Repetition
182.	Op amps	Lexical	Repetition

183.	integrated circuits	Lexical	Superordinate
184.	The device	Lexical	General word
185.	the circuit	Lexical	Superordinate
186.	The resulting device	Lexical	General word
187.	In each type ∇	Grammatical	Ellipsis
188.	the circuitry	Lexical	Superordinate
189.	the entire op amp	Lexical	Repetition
190.	the integrated circuit	Lexical	Superordinate
191.	the circuit	Lexical	Superordinate
192.	circuit elements	Lexical	Superordinate
193.	op amps	Lexical	Repetition
194.	each op amp circuit chip	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
195.	the circuit elements	Lexical	Superordinate
196.	circuit boards	Lexical	Superordinate
197.	general-purpose op amps	Lexical	Repetition
198.	circuit elements	Lexical	Superordinate
199.	power amplifier IC	Lexical	Superordinate
200.	an op amp user	Lexical	Repetition
201.	the device	Lexical	General word
202.	circuit analysis	Lexical	Superordinate

Appendix B - Text 2

Item of the keyword	Grammatical/ Lexical cohesion	Cohesive device
Operational amplifiers		
1. Operational amplifiers	Lexical	Repetition
2. this topic	Grammatical	General word
3. circuit exercises	Lexical	Superordinate
4. Operational amplifiers	Lexical	Repetition
5. op-amps	Lexical	Repetition
6. fundamental building blocks	Lexical	General word
7. circuit designs	Lexical	Superordinate
8. op-amps	Lexical	Repetition
9. basic circuits	Lexical	Superordinate
10. Voltage Followers	Lexical	Subordinate
11. The first circuit	Lexical	Superordinate
12. it	Grammatical	Reference
13. This circuit	Lexical	Superordinate
14. a voltage follower	Lexical	Subordinate
15. it	Grammatical	Reference
16. an opamp	Lexical	Repetition
17. it	Grammatical	Reference
18. opamps	Lexical	Repetition
19. a circuit	Lexical	Superordinate
20. opamps	Lexical	Repetition
21. The opamp 's input terminals	Lexical	Repetition
22. voltage follower circuit	Lexical	Subordinate
23. ideal opamps	Lexical	Repetition
24. it	Grammatical	Reference
25. any circuit	Lexical	Superordinate
26. the original circuit	Lexical	Superordinate
27. a voltage follower	Lexical	Subordinate
28. opamp rules	Lexical	Repetition and interpretation where <i>opamp</i> is used as an attribute
29. voltage follower	Lexical	Subordinate
30. hypothetical circuit	Lexical	Superordinate
31. opamps	Lexical	Repetition
32. the opamp 's output	Lexical	Repetition
33. voltage followers	Lexical	Subordinate
34. different circuits	Lexical	Superordinate

35.	opamps	Lexical	Repetition
36.	An Inverting Amplifier	Lexical	Subordinate
37.	their	Grammatical	Reference
38.	opamps	Lexical	Repetition
39.	amplifiers	Lexical	Superordinate
40.	They can	Grammatical	Reference
41.	an operational amplifier	Lexical	Repetition
42.	an opamp 's gain	Lexical	Repetition
43.	the next circuit	Lexical	Superordinate
44.	an inverting amplifier	Lexical	Subordinate
45.	circuit 's operation	Lexical	Superordinate
46.	opamp rules	Lexical	Repetition and interpretation where <i>opamp</i> is used as an attribute
47.	this circuit	Lexical	Superordinate
48.	the opamp rules	Lexical	Repetition and interpretation where <i>opamp</i> is used as an attribute
49.	opamp inputs	Lexical	Repetition and interpretation where <i>opamp</i> is used as an attribute
50.	this circuit	Lexical	Superordinate
51.	it	Grammatical	Reference
52.	The circuit	Lexical	Superordinate
53.	its input impedance	Grammatical	Reference
54.	an opamp	Lexical	Repetition
55.	an opamp	Lexical	Repetition
56.	voltage amplifier	Lexical	Subordinate
57.	an opamp	Lexical	Repetition
58.	it	Grammatical	Reference
59.	the opamp 's infinite gain	Lexical	Repetition
60.	the opamp output	Lexical	Repetition and interpretation where <i>opamp</i> is used as an attribute
61.	an V input	Grammatical	Ellipsis
62.	the topic V	Grammatical	Ellipsis
63.	opamps	Lexical	Repetition
64.	a circuit 's behaviour	Lexical	Superordinate
65.	an Inverter	Lexical	Subordinate
66.	inverting amplifier design	Lexical	Subordinate
67.	the inverting amplifier	Lexical	Subordinate
68.	the opamp	Lexical	Repetition
69.	the previous circuit	Lexical	Superordinate
70.	this circuit	Lexical	Superordinate
71.	this circuit	Lexical	Superordinate

72.	a noninverting amplifier	Lexical	Subordinate
73.	It	Grammatical	Reference
74.	noninverting amplifier	Lexical	Subordinate
75.	it	Grammatical	Reference
76.	this circuit	Lexical	Superordinate
77.	the inverting amplifier	Lexical	Subordinate
78.	the output V is positive	Grammatical	Ellipsis
79.	The inverting amplifier	Lexical	Subordinate
80.	The noninverting amplifier	Lexical	Subordinate
81.	Opamps	Lexical	Repetition
82.	circuit components	Lexical	Superordinate
83.	with them	Grammatical	Reference
84.	they can bring	Grammatical	Reference
85.	the other circuits	Lexical	Superordinate
86.	them	Grammatical	Reference
87.	cool circuits	Lexical	Superordinate
88.	opamps	Lexical	Repetition
89.	it	Grammatical	Reference

Appendix C - Text 3

Item of the keyword	Grammatical/Lexical cohesion	Cohesive device
Op Amps Characteristics		
1. Op Amps	Lexical	Repetition
2. Op Amp Circuits	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
3. operational amplifiers	Lexical	Repetition
4. circuits	Lexical	Superordinate
5. they're	Grammatical	Reference
6. op amps	Lexical	Repetition
7. An operational amplifier	Lexical	Repetition
8. op amp	Lexical	Repetition
9. an integrated circuit	Lexical	Superordinate
10. IC (integrated circuit)	Lexical	Superordinate
11. op amp	Lexical	Repetition
12. op amps	Lexical	Repetition
13. IC	Lexical	Superordinate
14. an IC	Lexical	Superordinate
15. op amp	Lexical	Repetition
16. an IC	Lexical	Superordinate
17. op amps	Lexical	Repetition
18. Op amps	Lexical	Repetition
19. circuits	Lexical	Superordinate
20. Op Amp Characteristics	Lexical	Repetition and interpretation where <i>op amp</i> is used as an attribute
21. Op amps	Lexical	Repetition
22. circuits	Lexical	Superordinate
23. an op amp	Lexical	Repetition
24. an op amp	Lexical	Repetition
25. The op amp	Lexical	Repetition
26. a differential amplifier	Lexical	Subordinate
27. them	Grammatical	Reference
28. a differential amplifier	Lexical	Subordinate
29. it	Grammatical	Reference
30. differential amplifier	Lexical	Subordinate
31. it	Grammatical	Reference
32. operational amplifiers	Lexical	Repetition
33. op amps	Lexical	Repetition

34.	they	Grammatical	Reference
35.	most ▼ are	Grammatical	Ellipsis
36.	op amps	Lexical	Repetition
37.	them	Grammatical	Reference
38.	op amps	Lexical	Repetition
39.	the op amp	Lexical	Repetition
40.	op amps	Lexical	Repetition
41.	they	Grammatical	Reference
42.	The 741	Lexical	Subordinate
43.	op amp	Lexical	Repetition
44.	this	Grammatical	Reference
45.	the 741	Lexical	Subordinate
46.	circuits	Lexical	Superordinate
47.	this	Grammatical	Reference
48.	This	Grammatical	Reference
49.	thing	Lexical	General word
50.	op amps	Lexical	Repetition
51.	an op amp	Lexical	Repetition