BRNO UNIVERSITY OF TECHNOLOGY
VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION
FAKULTA ELEKTROTECHNIKY A KOMUNIKAČNÍCH TECHNOLOGIÍ

DEPARTMENT OF FOREIGN LANGUAGES
ÚSTAV JAZYKŮ

FUNCTIONS OF PASSIVE VOICE STRUCTURES IN VARIOUS GENRES OF ESP COMPARED WITH CZECH LANGUAGE USE.

FUNKCE TRPNÉHO RODU V ANGLICKÉM JAZYCE RŮZNÝCH ŽÁNRŮ ODBORNÉHO STYLU V POROVNÁNÍ S ČESKÝM JAZYKEM.

BACHELOR'S THESIS
BAKALÁŘSKÁ PRÁCE

AUTHOR Dominik Zemánek
AUTOR PRÁCE

SUPERVISOR PaedDr. Alena Baumgartnerová
VEDOUCÍ PRÁCE

BRNO 2022

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION

Bachelor's Thesis

Bachelor's study field **English in Electrical Engineering and Informatics**

Department of Foreign Languages

Student: Dominik Zemánek ***ID:*** 200294

Year of study: 3 ***Academic year:*** 2021/22

TITLE OF THESIS:

Functions of Passive Voice Structures in Various Genres of ESP compared with Czech Language Use.

INSTRUCTION:

Based on the research of specialized literature describe passive voice functions in English and compare them with Czech language.

RECOMMENDED LITERATURE:

1. Krhutová M.: The language of Electrical Engineering as a Special Province. Brno, Akademické nakladatelství CERM, 2007.
2. Stevens M.: Scientific Style. Thornleigh, N.S.W., ScienceScape Editing, 2005.
3. Dušková L. a kol.: Mluvnice současné angličtiny na pozadí češtiny. Praha, Academia, 1994.
4. Knittlová D.,Rochovanská I.: Funkční styly v angličtině a češtině I.díl. Olomouc, Palacký University Olomouc, 1977.

Date of project specification: 10. 2. 2022 ***Deadline for submission:*** 31. 5. 2022

Supervisor: PaedDr. Alena Baumgartnerová

doc. PhDr. Milena Krhutová, Ph.D.
Subject Council chairman

Abstract

This thesis characterizes passive voice structures and their formation, meaning, usage, and functions based on the research of related literature. With its inherent change of word order, the passive voice provides writers with more options of text organization and enables them to emphasize some words while omitting others. Especially in scientific and administrative style, this can help direct readers' attention to the subject matter, making the text impersonal and objective. The respective aspects of passive structures are described in terms of grammar, semantics, stylistics, and translation, and their use in Czech is also explained and contrasted with English. Subsequently, English for specific purposes is characterized, and finally, the frequency and functions of passives are analyzed in technical texts of three different genres. This serves to confirm and illustrate the differences between the genres and languages, as each English text is also compared with a similar Czech one.

Keywords

Passive voice, passive structures, style of science and technology, English for specific purposes, analysis, comparison

Abstrakt

Tato práce popisuje pasivní konstrukce a jejich tvoření, význam, použití a funkce na základě rešerše související literatury. Trpný rod a s ním související změna slovosledu dávají autorům více možností uspořádání textu a zároveň umožňují zdůraznit, či naopak vynechat některá slova. To může především ve vědeckém a administrativním stylu pomoci soustředit pozornost čtenáře na popisované téma, což činí text neosobním a věcným. Jednotlivé rysy pasivních konstrukcí jsou popsány z pohledu gramatiky, sémantiky, stylistiky a překladu a jejich používání v češtině je také vysvětleno a porovnáno s angličtinou. Následně je charakterizována angličtina pro specifické účely a poslední kapitola pak analyzuje četnost a funkce trpného rodu v technických textech tří různých žánrů. To má za úkol potvrdit a znázornit rozdíly mezi danými žánry i jazyky, jelikož je každý anglický text porovnán s podobným českým textem.

Klíčová slova

Trpný rod, pasivum, odborný styl, angličtina pro specifické účely, rozbor, porovnání

Rozšířený abstrakt

Bakalářská práce zpracovává téma trpného rodu a popisuje pasivní konstrukce, jejich tvoření, význam, použití a funkce na základě rešerše související literatury. Rozbor tří dvojic odborných textů v angličtině a češtině má pak za úkol znázornit rozdílnosti používání pasiv v různých žánrech a jazycích. Zejména v angličtině dává související změna slovosledu autorům více možností uspořádání textu a zároveň trpný rod umožňuje některé informace zdůraznit, či naopak vynechat. To může především ve vědeckém a administrativním stylu pomoci soustředit pozornost čtenáře na popisované téma, což činí text neosobním a věcným.

Jak vysvětluje první kapitola, trpný rod narozdíl od rodu činného vyjadřuje, co se stalo předmětu, a umožňuje podmět, tedy konatele děje, vynechat, nebo naopak zdůraznit. Obdobně jako v češtině je v angličtině konstrukce trpného rodu tvořena vyčasovaným pomocným slovesem *to be* a trpným příčestím plnovýznamového slovesa. V této standardní formě lze trpný rod použít pro přechodná slovesa s jedním či dvěma předměty, se způsobovými slovesy a v různých slovesných časech, které jsou znázorněny na příkladech. Dále kapitola vysvětluje použití pomocného slovesa *to get*, vazby s předložkami, a ostatní druhy anglických pasivních konstrukcí jako infinitivy, gerundia, dvojitá pasiva, vazbu *have something done* a takzvaná ‚semi-passives' a ‚pseudo-passives'.

Trpný rod naopak nelze použít u sloves nepřechodných, která zejména vyjadřují stavy a nedisponují předmětem. Přitom je třeba mít na paměti, že slovesa mohou mít více významů, jejichž přechodnost se může lišit. V češtině se mimo opisných konstrukcí odpovídajících anglickému pasivu používají zejména zvratné tvary, ale činný rod i ve velmi formálních a věcných textech výrazně převažuje.

Z pohledu sémantiky je důležitou vlastností trpného rodu možnost vynechat konatele děje, ať už proto, že není znám, nebo záměrně, například v zájmu neosobního vyznění textu. I pokud nejsou žádné informace vynechány, může slovosled pasivní konstrukce v angličtině pomoci zdůraznit slova na konci věty nebo text lépe uspořádat. Druhá kapitola dále popisuje několik druhů aktivních konstrukcí, které nesou pasivní význam, takzvaná mediopasiva.

Třetí kapitola se zabývá používáním trpného rodu v různých funkčních stylech a krátce popisuje odborný styl vědy a techniky, ve kterém se, vedle stylu administrativního, trpný rod vyskytuje nejvíce. Naproti tomu v běžné řeči nejsou pasiva příliš častá, protože komunikace v rodu činném bývá jednodušší a jasnější. Proto také někteří jazykovědci oponují konvencím odborného stylu a tvrdí, že přílišné a neuvážené používání trpného rodu může přinášet zbytečné komplikace a zastírat realitu.

Problematika překladu je popsána ve čtvrté kapitole, která podrobněji porovnává rozdílnosti pasivních konstrukcí používaných v češtině a v angličtině. Při překládání z angličtiny je žádoucí zohlednit to, že trpný rod je v češtině nejen méně častý, ale také z velké části využívá zvratných pasiv, takže prostý překlad všech anglických pasiv do

opisných tvarů může znít velmi nepřirozeně. Nejprve je proto třeba uvážit, proč byl trpný rod v původním textu použit a jakou funkci plní a poté najít odpovídající český protějšek.

Pro účely rozboru textů je následně charakterizována angličtina pro specifické účely (ESP) jakožto protějšek všeobecné angličtiny. Jedná se o výuku zaměřenou na určitý obor s ohledem na související slovní zásobu a komunikační dovednosti. Žáky těchto kurzů jsou tedy studenti vysokých škol nebo zaměstnanci v oborech jako věda a technika, medicína, právo, podnikání a jiné. Stručně je uveden i vývoj tohoto odvětví a jeho typické rysy.

Poslední kapitola pak analyzuje a porovnává tři anglické a odpovídající české texty z hlediska četnosti pasivních konstrukcí, jejich druhů a funkcí. Jde o texty různých žánrů z oblasti vědy a techniky, konkrétně o populárně naučný článek o vývoji lidarových senzorů pro roboty, úryvek z vysokoškolského skripta o zpětnovazebním řízení a úryvek z disertační práce v oblasti robotiky.

S ohledem na požadovanou míru objektivity lze očekávat nejvíce pasiv v disertační práci, a naopak nejméně v populárně naučném stylu, který je přístupnější a snaží se čtenáře zaujmout. Zároveň se předpokládá, že je trpný rod v angličtině častější než v českých textech daného žánru, a zatímco se angličtina omezuje na pasiva opisná, čeština by měla často využívat zvratné formy.

Z výsledů rozboru vyplývá, že je skutečně četnost pasiv výrazně vyšší v disertačních pracích, kde tvoří téměř třetinu slovesných konstrukcí, nižší ve skriptech a nejnižší v populárně naučných článcích. V angličtině byla trpná příčestí používána pro zhušťování textu a obecně pasiva pomáhala kohezi. Pokud ale jde o rozdílnost jazyků, vybrané texty vykazovaly velmi podobnou četnost konstrukcí trpného rodu v obou jazycích a prokazatelně menší byl pouze počet opisných pasiv v češtině, protože využívá také formy zvratné. Tento výsledek byl pravděpodobně způsoben výběrem textů a další výzkum by se tedy mohl zaměřit na kvantitativní analýzu většího množství delších textů včetně ústních žánrů, případně na časový vývoj četnosti pasivních konstrukcí v českých odborných textech.

Bibliographic citation

ZEMÁNEK, Dominik. *Funkce trpného rodu v anglickém jazyce různých žánrů odborného stylu v porovnání s českým jazykem*.. Brno, 2022. Dostupné také z: https://www.vutbr.cz/studenti/zav-prace/detail/142533. Bakalářská práce. Vysoké učení technické v Brně, Fakulta elektrotechniky a komunikačních technologií, Ústav jazyků. Vedoucí práce Alena Baumgartnerová.

Prohlášení

Prohlašuji, že svou bakalářskou práci na téma *Funkce trpného rodu v anglickém jazyce různých žánrů odborného stylu v porovnání s českým jazykem* jsem vypracoval samostatně pod vedením vedoucí bakalářské práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

Jako autor uvedené bakalářské práce dále prohlašuji, že v souvislosti s vytvořením této závěrečné práce jsem neporušil autorská práva třetích osob, zejména jsem nezasáhl nedovoleným způsobem do cizích autorských práv osobnostních a jsem si plně vědom následků porušení ustanovení § 11 a následujících autorského zákona č. 121/2000 Sb., včetně možných trestněprávních důsledků vyplývajících z ustanovení části druhé, hlavy VI. díl 4 Trestního zákoníku č. 40/2009 Sb.

V Brně dne: 30. května 2022 ----------

podpis autora

Acknowledgement

I would like to thank my bachelor's thesis supervisor PaedDr. Alena Baumgartnerová for her generous support, valuable feedback, and endless patience.

Brno, May 30, 2022 ----------

Author's signature

Contents

INTRODUCTION

Passive voice structures are an important linguistic tool used not only in texts of science and technology. They can help direct readers' attention to the topic and enable writers to change the word order to achieve a better organization of the text. Even in other styles, passives provide the possibility to express what happened while omitting who did it or, conversely, to put more emphasis on certain words.

Admittedly, the passive voice is often thoroughly described in literature dealing with grammar, semantics, or stylistics. It is, however, rarely addressed separately and extensively from all the linguistic perspectives. The aim of this bachelor's thesis is to provide a comprehensive overview describing the linguistic characteristics of the passive voice and its functions based on the research of several linguists. Subsequently, three pairs of texts are analyzed to illustrate the differences in the usage and functions of passive voice structures in different scientific genres and in English compared with Czech.

In the first chapter, the topic is approached from the grammatical point of view, defining grammatical voice and specifying the possibilities and limitations of passive structure formation and usage. The usage of passives in Czech is briefly described too.

The second chapter focuses on the specifics of passives in terms of semantics. It addresses the possible differences in the meaning of passive sentences and their active counterparts. Active constructions which carry passive meaning are described as well.

In the third chapter, the usage of the passive and active voice in different functional styles is explained. The style of science and technology is characterized and the reasons to use passives in it are outlined in contrast with the style of conversation. It is then followed by several arguments against the excessive use of passives in scientific texts.

In the fourth chapter, the topic of translation of passive structures from English into Czech is covered. Certain differences between the two languages are mentioned that ought to be considered when translating and adapting a text. The passive is used less frequently in Czech and often employs different linguistic means, such as reflexive passives or the active voice with a general subject, to imply the same meaning.

The fifth chapter then describes the characteristics of English for specific purposes, and finally, the last chapter analyzes the functions of passive voice structures in different genres of ESP and in comparison with similar Czech texts. The three pairs of texts chosen range in terms of the required formality and impersonality, with a popular scientific article, an extract from a university textbook, and an extract from a doctoral thesis.

The grammatical aspects of passive voice constructions described in this paper are largely based on the research of professor Libuše Dušková, an influential Czech Anglicist, namely on the exhaustive information provided in her book *Mluvnice současné angličtiny na pozadí češtiny*, here paraphrased in English. Other frequently referenced sources include *Practical English Usage* by Michael Swan, *Oxford Learner's Grammar* by John Eastwood, and *Funkční styly v angličtině a češtině* by Dagmar Knittlová.

1. GRAMMATICAL ASPECTS OF THE PASSIVE VOICE

This chapter covers the grammatical rules, possibilities, and limitations concerning passive structures in English. Firstly, the concept of grammatical voice is defined followed by the explication of how different kinds of passive structures can be formed and used. Furthermore, it is made clear which expressions prevent the formation of passives, and finally, the use of passives in Czech is described and compared with English.

1.1 Grammatical voice

Generally, in both English and Czech, actions can be expressed in two ways, either by introducing the active subject of the sentence and stating what they did (*Somebody did something.*), or by placing the passive object itself into the role of the subject and stating what was done unto it (*Something was done by someone.*). This property of verbal structures is called the grammatical voice. Besides stylistic features, the choice of the grammatical voice often depends on what is new information in the context.

As Michael Swan explains: "The subject of an active verb is usually the person or thing that does the action, or that is responsible for what happens." (2016, p. xx) In linguistic terms, this is the *agent* of the verbal structure. Meanwhile, "the subject of a passive verb form is usually the person or thing that is affected by the action of the verb." (2016, p. xxv) This is referred to as the *patient*. (The terms *agent* and *patient* are going to be used extensively in this thesis.)

1.2 Passive structures

In other words, passives are such structures that primarily express what happened or what was done, with the person responsible for the action being mentioned afterwards or even omitted. Practically, that means that the object of a sentence becomes the grammatical subject, and conversely, the subject, if it is still included, becomes an object. The grammatical subject of a passive sentence then 'suffers', 'experiences', or 'receives' the action of the verb. The formal equivalent of English passive structures in Czech are compound passives, the usage of which is relatively limited, as will be explained later. (Dušková, 2006)

Dušková (2006) claims that the active voice can be seen as the default grammatical voice, since its structure is simpler, it can be used with any lexical verb, and it generally carries a somewhat broader meaning. Meanwhile, the passive voice can only be used with verbs that have an object, but not with all of them because of further limitations based on the nature of the verb, its meaning, and the tense used. One of the most common reasons

to employ the passive voice is the possibility to omit the agent of the sentence, which cannot be achieved in the active voice.

1.3 Forms of the passive

Passive verbs are composed of a form of the auxiliary verb *to be* and the passive participle of a lexical verb, which has the same form as a past participle. Especially in casual speech, the auxiliary verb *to get* can sometimes be used instead. (Dušková, 2006)

Passive structures are frequently used in simple and perfect tenses. In addition, Dušková (2006) specifies that passive continuous forms are predominant in the present and past tense, while the future continuous tense and all perfect continuous tenses are very rare. This is due to the inherent accumulation of auxiliary verbs, and such tenses would therefore preferably be expressed by other linguistic means. The corresponding negative and question forms are, as customary, created by adding the negative particle *not* to the first auxiliary verb and by changing the word order, respectively.

The construction of passives is illustrated in the following examples and contrasted with their possible active counterparts. The abbreviations *sb*, *nb*, and *ab* represent *somebody*, *nobody*, and *anybody*, respectively. For each sentence, one of the possible Czech translations is presented, often using other linguistic means to express passivity.

Simple tenses

- **Present simple**

Passive voice	Active voice
The bench is (not) painted.	*Sb/Nb paints the bench.*
The flowers are (not) watered.	*Sb/Nb waters the flowers.*
Is the gate (not) opened?	*Does ab/nb open the gate?*

Czech translation: *Ta lavička se (ne)natírá. Ty květiny se (ne)zalévají. (Ne)otevírá se ta brána?*

- **Past simple**

Passive voice	Active voice
The bench was (not) painted.	*Sb/Nb painted the bench.*
The flowers were (not) watered.	*Sb/Nb watered the flowers.*
Was the gate (not) opened?	*Did ab/nb open the gate?*

Czech translation: *(Ne)natřeli tu lavičku. (Ne)zalili ty květiny. (Ne)otevřeli tu bránu?*

- **Future simple**

Passive voice	Active voice
The bench will (not) be painted.	*Sb/Nb will paint the bench.*
The flowers will (not) be watered.	*Sb/Nb will water the flowers.*
Will the gate (not) be opened?	*Will ab/nb open the gate?*

Czech translation: *(Ne)natřou tu lavičku. (Ne)zalijí ty květiny. (Ne)otevřou tu bránu?*

Perfect tenses

- **Present perfect**

Passive voice	Active voice
The bench has (not) been painted.	*Sb/Nb has painted the bench.*
The flowers have (not) been watered.	*Sb/Nb has watered the flowers.*
Has the gate (not) been opened?	*Has ab/nb opened the gate?*

Czech translation: *Lavička je/není natřena. Květiny (ne)jsou zality. Je/není brána otevřena?*

- **Past perfect**

Passive voice	Active voice
The bench had (not) been painted.	*Sb/Nb had painted the bench.*
The flowers had (not) been watered.	*Sb/Nb had watered the flowers.*
Had the gate (not) been opened?	*Had ab/nb opened the gate?*

Czech translation: *Lavička (ne)byla natřena. Květiny (ne)byly zality. (Ne)byla brána otevřena?*

- **Future perfect**

Passive voice	Active voice
The bench will (not) have been painted.	*Sb/Nb will have painted the bench.*
The flowers will (not) have been watered.	*Sb/Nb will have watered the flowers.*
Will the gate (not) have been opened?	*Will ab/nb have opened the gate?*

Czech translation: *Lavička (ne)bude natřena. Květiny (ne)budou zality. (Ne)bude brána otevřena?*

Continuous tenses

- **Present continuous**

Passive voice	Active voice
The bench is (not) being painted.	*Sb/Nb is painting the bench.*
The flowers are (not) being watered.	*Sb/Nb is watering the flowers.*
Is the gate (not) being opened?	*Is ab/nb opening the gate?*

Czech translation: *Tu lavičku teď (ne)natírají. Ty květiny teď (ne)zalévají. (Ne)otevírají teď tu bránu?*

- **Past continuous**

Passive voice	Active voice
The bench was (not) being painted.	*Sb/Nb was painting the bench.*
The flowers were (not) being watered.	*Sb/Nb was watering the flowers.*
Was the gate (not) being opened?	*Was ab/nb opening the gate?*

Czech translation: *Ta lavička se (ne)natírala. Ty květiny se (ne)zalévaly. (Ne)otevírala se ta brána.*

* **Future continuous (rare)**

Passive voice	Active voice
The bench will (not) be being painted.	*Sb/Nb will be painting the bench.*
The flowers will (not) be being watered.	*Sb/Nb will be watering the flowers.*
Will the gate (not) be being opened?	*Will ab/nb be opening the gate?*

Czech translation: *Ta lavička se (ne)bude natírat. Ty květiny se (ne)budou zalévat. (Ne)bude se ta brána otevírat?*

Perfect continuous tenses (rare)

* **Present perfect continuous**

Passive voice	Active voice
The bench has (not) been being painted.	*Sb/Nb has been painting the bench.*
The flowers have (not) been being watered.	*Sb/Nb has been watering the flowers.*
Has the gate (not) been being opened?	*Has ab/nb been opening the gate?*

No appropriate Czech translation.

* **Past perfect continuous (rare)**

Passive voice	Active voice
The bench had (not) been being painted.	*Sb/Nb had been painting the bench.*
The flowers had (not) been being watered.	*Sb/Nb had been watering the flowers.*
Had the gate (not) been being opened?	*Had ab/nb been opening the gate?*

No appropriate Czech translation.

* **Future perfect continuous (rare)**

Passive voice	Active voice
The bench will (not) have been being painted.	*Sb/Nb will have been painting the bench.*
The flowers will (not) have been being watered.	*Sb/Nb will have been watering the flowers.*
Will the gate (not) have been being opened?	*Will ab/nb have been opening the gate?*

No appropriate Czech translation.

In terms of modality, no specifics are involved, so all modal and semi-modal verbs can be used, as well as phrases such as *used to* or *be going to*, which are followed by a passive infinitive. (Eastwood, 2005) Examples: *The emergency exit must not be locked.*

This bill ought to have been paid weeks ago. A new shopping center is going to be built in this area.

Oxford Learner's Grammar (Eastwood, 2005) describes the use of the auxiliary verb *to get* in passives as mostly informal and rather limited, but it can provide a more dynamic meaning. *Get* is also used when talking about accidents or things happening incidentally, as a part of a larger operation. For example: *Our car got stolen yesterday. The vase got broken when we moved house. Everyone got moved to a new office during the reorganization.*

Furthermore, *to get* is typically used in fixed idiomatic expressions where the use of *to be* would not be possible, such as *get engaged/married/divorced*, *get washed/shaved*, *get dressed/changed*, *get started*, or *get lost*. (Eastwood, 2005)

In passives, the agent responsible for the action is often omitted, but it can also be mentioned at the end of the passive structure, preceded by the preposition *by*. According to Dušková (2006), this is often done in order to emphasize the agent or to introduce it as new information. For example: *This picture was painted by my daughter.*

In the case of inanimate agents, the preposition may differ depending on the collocation with verbs and the meaning desired. Examples: *She was treated by antibiotics. We were surprised at the result. They are not interested in astronomy.*

Particularly, the preposition *with* implies that the action was done by someone using the given tool or object. Compare: *The car was hit by a falling rock. The victim was hit with a baton.*

In the case that the patient is an object of a preposition, the construction of the passive remains the same and the preposition is kept as a part of the verb phrase following the participle. This applies even to verbal idioms with prepositions. For instance: *The freshly painted bench should not be sat on. Such out-of-date practices should be done away with.*

Meanwhile in Czech, all objects of prepositions require the usage of a case other than nominative, which restricts them from becoming the subject. A construction without a subject, or more accurately with an unexpressed subject, is therefore used (Dušková, 2006), such as: *Na čerstvě natřenou lavičku by se nemělo sedat.*

1.4 When and how the passive can be used

Passive structures can, by definition, be formed exclusively using transitive verbs. That is because intransitive verbs do not provide any direct nor indirect object which could become the subject of the passive structure. Dušková (2006) also notes that the transitiveness of certain verbs can differ in various languages and even within one language depending on their meaning in a text.

1.4.1 Monotransitive verbs

Verbs which take only one direct object are called monotransitive. When they are used in the passive voice, in both English and Czech alike, the object of the active construction

becomes the subject of the passive construction, as was explained earlier.

But in Czech, as Dušková (2006) points out, this can further be complicated by certain verb patterns which require the usage of genitive, dative, or instrumental case. As a result, the patient of the Czech sentence then cannot truly fulfill the role of the subject like it does in English, so it is instead substituted by an unexpressed pronoun *it* acting as the subject of the sentence.

Transitive phrasal verbs, such as *bring up, let down,* or *fill in*, form passives in the same way including phrasal verbs that collocate with a preposition. (Dušková, 2006)

Examples: *The house had been abandoned. The sticker should not be removed. This topic has been brought up several times. The schedule must be adhered to.*

There are certain verbs which are predominantly used in the passive voice. Besides the verb *to be born*, these are also *to be dubbed*, *to be populated*, *to be hospitalized*, or *to be strewn*. The active form of such verbs is then less common but possible: *My brother was born in May. Most animals bear their young in the spring.*

Furthermore, as Swan (2016), Eastwood (2005), and others explain, the monotransitive verbs *say*, *report*, *consider*, *expect*, *think*, *believe*, *know*, *understand*, *estimate*, *find*, and similar verbs of reporting can be used to report what an unspecified group says (considers, thinks, ...) about the patient, and there are two special ways to form such a passive.

The first form uses the pronoun *it* as the subject, and the passive is then followed by a that-clause: *It is expected that Martin will come today. It was estimated that the flood had killed over 200 people.*

The second form is with the patient standing as the subject and the passive followed by an infinitive phrase: *Martin is expected to come today. The flood was estimated to have killed over 200 people.*

1.4.2 Ditransitive verbs

Ditransitive verbs, such as *ask*, *deny*, *give*, *offer*, or *send*, take a direct as well as an indirect object, which enables the passive structure to be formed in two different ways. Although Czech only allows the direct object to take the role of the subject, Dušková (2006) specifies that in English it can be either of the objects as long as the direct object is not expressed using an infinitive or a subordinate clause. The choice of the passive structure's subject then depends on the desired word order and consequently the information structure of the sentence.

Widdowson (2004) then explains that the subject of a sentence is typically a part of the theme (topic), which refers to what is already known from context, while the new information is provided by the second part of the sentence, the rheme (comment), and is naturally given more emphasis. It is therefore preferable for the object that provides more communicative dynamism to remain an object in the passive sentence. Examples: *We*

were awarded the first prize. All the flowers were given to me. She has been promised a promotion. He was asked a difficult question.

Dušková (2006) adds that in case the direct object is chosen to be the subject, the indirect object is preceded by the preposition *to* or can seldom stand without a preposition. Examples: *Two sheets of paper will be given to each of you. The pleasure of seeing you was denied me.*

1.4.3 Passive infinitives

Passive infinitives are non-finite constructions composed of the infinitive *to be* and the passive participle of a lexical verb. They are often used after phrases like *used to* and *going to*, after nouns or the verb *to be* to talk about obligation, after the adjectives *likely* and *ready*, with verbs like *congratulate*, *encourage*, or *avoid* to express value judgements, or in phrases such as *nowhere to be seen/found*. (Swan, 2016) Consider the following examples: *She is going to be transferred to a different hospital. The chairs to be fixed are outside. The helicopter is to be disassembled. The offer is likely to be rejected. Such behavior is to be encouraged. My glasses are nowhere to be found.*

Swan (2016) also points out that obligations can often be expressed using both the passive and active infinitive: *There is a lot of work to do / to be done.*

There is, however, a difference in their level of personality, so active infinitives are used in sentences which are personal: *I have a lot of work to do. Sarah has received a registration form to fill in.*

Meanwhile, passive infinitives focus on the action rather than the person: *The truck is full of packages to be delivered. The forms to be filled in are in the accountant's office.*

Sometimes, active and passive infinitives can even carry different meanings, as be seen in this example: *It is too late to fix it, there is nothing to be done now. I was bored because here was nothing to do at the hotel.*

The passive participle in a passive verb phrase can be replaced by a passive infinitive as well. Swan (2016) demonstrates that such phrases then indicate an imperative meaning, which is why they are often used in notices and instructions: *All windows are to be closed. This cover is not to be removed.*

Sometimes, only the passive infinitive is used: *To be taken three times a day.*

1.4.4 Passive gerunds

Passive gerunds consist of an active verb, the gerund *being*, and a passive participle. They emphasize that the subject of the sentence is being acted upon as can be seen in the following examples: *She immediately reported being robbed. Do you not enjoy being praised?*

The perfect gerund *having been* can be used as well when talking about past experiences: *Henry did not mention having been hit by a car.*

1.4.5 Passive participle as a postmodifier

Another type of non-finite passive constructions is the passive participle standing by itself, without an auxiliary verb, as a postmodifier of a noun. (Biber et al., 1999) Although premodifiers are considered to be adjectives, when a passive participle is used as a postmodifier of a noun, it is a verb form, and a by-phrase specifying the agent can follow: *Use the recommended motor oil. / Use the motor oil recommended by the manufacturer.*

Especially in scientific texts, passive participles are frequently used as a means of condensation because, effectively, the postmodifier in this form is comparable to a finite relative clause: *We are investigating a fossil that was discovered by local children / a fossil discovered by local children.*

1.4.6 Double passives

The Oxford Dictionary of English Grammar lists the double passive as a grammatical construction whose acceptability varies. It is a clause containing a conjugated passive verb followed by a passive infinitive. "Verbs . . . that are also possible in the pattern verb + object + passive infinitive (e.g. *We expect certificates to be despatched*) seem grammatical when they occur in the double passive construction [(e.g. Certificates are expected to be despatched next week)]. Verbs that do not fit this pattern with a single passive (e.g. *We propose receipts to be issued) do not happily take a double passive either." (Chalker & Weiner, 1994, p. 125)

1.4.7 Have something done

To have something done is a particular kind of passive structures, where the auxiliary verb is *to have*, or alternatively *to get*, which is informal. This form is especially used when the action has been asked for by the patient, as in *I had/got my hair cut*, but it can also express general experience such as: *We had our house broken into. The park has hundreds of benches damaged every year.*

Oxford Learner's Grammar (Eastwood, 2005) also mentions a similar pattern: *to have someone do something. I had the garage service my car* is then equivalent to *I had/got my car serviced by the garage.*

1.4.8 Semi-passives and pseudo-passives

As opposed to standard or 'central' passive constructions, semi-passives have both verbal and adjectival properties. While they can be converted into the active voice, they can also "be coordinated with an adjective; the participle can be modified by adverbs such as *more*, *most*, *quite*, etc.; and the verb *be* can be replaced by lexical copular verbs such as *look*, *seem*, etc." (Chalker & Weiner, 1994, p. 357) Examples: *The whole family were upset and angry. Tom was quite worried about the exam results. Sarah didn't seem interested in his explanation.*

Pseudo-passives, on the other hand, are constructions that resemble central passives, but only have adjectival properties. They do not have an active counterpart, nor can they indicate an agent. (Chalker & Weiner, 1994) Examples: *My homework is finished now. The bedsheets are washed already.*

1.5 When the passive cannot be used

Michael Swan's Practical English Usage (2016) states that intransitive verbs are never used in passive forms. Examples of intransitive verbs include *arrive*, *come*, *die*, *fall*, *go*, *happen*, *kneel*, *smile*, and *stay*. Sentences like these therefore have no passive equivalent: *She arrived early. Snow is falling. We will stay at home.*

There are also certain transitive verbs, predominantly stative verbs, whose passive forms are rarely used. Dušková (2006) explains this phenomenon in detail and specifies that transitive verbs can only form a passive if their object is involved in the action or affected by it. The possibility to form a passive structure can, however, also depend on the semantic meaning of the verb and on the nature of the object. Expressions which prevent the use of the passive therefore include transitive verbs such as *become*, *belong*, *consist*, *escape*, *equal*, *lack*, *last*, or *resemble*, idiomatic phrases such as *take a look* or *make a living*, or any reflexive, infinitive, and gerundial objects or object clauses.

Additionally, Dušková (2006) lists several verbs whose transitiveness depends on their semantic meaning in a text. These include *cost*, *fit*, *hold*, *mean*, *measure*, *run*, *suit*, and *weigh*. Compare:
This bottle holds exactly 1.75 liters of water. The conference will be held in Paris.
I did not mean to offend you. These exercises are not meant to be difficult.
The screen measures 42 inches diagonally. The patient's blood pressure was measured.
I had to run to catch the train. The program should be run on both computers.

Furthermore, except for rare passive infinitive structures, the verbs *to have* and *to get* generally do not form passives because they have their logical equivalents in the active verb *to be* and in the passive verb *to be given*, respectively. As a result, utterances such as *he has red shoes* and *his shoes are red* or *he got a hat* and *a hat was given to him* carry the same meaning. (Dušková, 2006) One example of the passive infinitive structures is: *There are more photos to be had near the lake.*

1.6 Passive voice in Czech

Despite the means of forming passive structures being relatively similar in Czech and in English, the usage of compound passives is rather uncommon in the contemporary Czech language, and they tend to sound unnatural, bookish, and overly impersonal. The passives are formed in the same way, using the auxiliary verb *být* and the passive participle of a verb, but the participle is different for each person and number. As was already mentioned before, only the direct object of an active sentence can become the subject of a passive

one, as opposed to English. (Dušková, 2006) Additionally, the agent can be expressed using the instrumental case, but the inclusion of the agent is quite rare in Czech, and an active structure is often preferred. Vlková (2020) claims that compound passives are especially used in sentences that express the final state of the subject or the actions that are directly being done unto it.

The other type is the reflexive passive, which is arguably more frequent in general speech and is constructed using an active form of the verb together with the reflexive pronoun *se*. This form is only limited to the third person, however, and the agent is inevitably omitted since the construction does not allow for it to be expressed. Vlková (2020) suggests that with their strong focus on the action itself, reflexive passives also provide a more dynamic formulation, which positions them halfway between compound passives and active constructions. They are frequently used to express general statements, to intentionally suppress the agent, as well as in connection with conditional phrases.

Because the system of conjugation of Czech verbs usually produces a unique verb form for each person and number, the subject of a sentence can be left unexpressed if it is clear from the context. In English, no such distinction exists, except for the suffix *-s* for the third person singular and the verb to be, therefore the subject of the sentence must always be expressed in the active voice.

Also, as opposed to English, where the verb *to be* is used very frequently as an auxiliary verb, it tends to sound rather repetitive in Czech and therefore it is desirable to look for other synonymous expressions instead, depending on the given sentence.

2. SEMANTIC ASPECTS OF THE PASSIVE VOICE

This chapter deals with the meaning that passive structures convey and how it can be different from their active equivalents. Subsequently, the active forms which can carry a passive meaning in English are described.

2.1 Changes in meaning when using the passive voice

Even though the meaning of an active structure and its passive counterpart remains identical as long as no content is omitted, in an analytic language such as English, where the word order is fixed, this allows for a shift in emphasis as the agent is placed at the end of the sentence. (Crystal, 2005) The combination of passive and active structures then enables writers to form cohesive chains, order information logically, and to lead the reader's focus. In a technical text, for example, this can help keep the same subject in consecutive sentences, thus focusing on the subject matter and not on the agents.

In Czech, as Dušková (2006) remarks, the word order can be changed relatively freely, but a feature that the two languages share is that the preverbal part of the sentence typically carries the theme. The rheme is then expressed by the postverbal part or by the verb itself if it terminates the sentence. Thus, the sentence begins with the information that is already known and then transitions to introducing new information. As usually, there are exceptions to this rule, and other constituents can occasionally provide more communicative dynamism if their rhematic nature is marked by other lexical means. (Dušková, 2006)

Arguably, the usage of passives is predominantly motivated not by the need to emphasize but to omit the agent. David Crystal (2005) describes several reasons why the agent may be omitted. Firstly, the writer may have no knowledge of the agent, or it may be impossible to determine who it is. If the agent is known, on the other hand, the author may deliberately decide not to provide this information, whether it is to hide their identity or to avoid particularizing when the aim is to focus on objective matters. Furthermore, there might be no need to identify the agent if it is obvious from the context. Lastly, the omission can further help reduce the personal tone of the message, which may be desirable in administrative, legal, or academic discourse.

There are also such passive constructions that do not imply any agent at all, such as: *The cabin is situated/located near a lake. The electric field is transferred along the lines of force. She is opposed to the idea. The plain is exposed to northern winds*. Since Dušková (2006) states that the passive is agentless, and, in most cases, the passive verb can be replaced by an active one with the subject remaining the same, it could be argued that these are exceptional examples of intransitive passive constructions. Alternatively, they might be considered pseudo-passives.

Additionally, Michael Swan (2016) mentions a single example in which the passive and active form of a verb are interchangeable in a sentence and can convey identical meaning – when talking about accidental drowning: *He (was) drowned while trying to swim across a river.*

2.2 Active forms with passive meaning

Grammar and meaning can often diverge. One of the examples of this, as described by Dušková (2006), are so-called mediopassive structures, active structures with a subject that corresponds with the direct object of a transitive verb. With the patient standing as the subject, this 'middle' voice is grammatically active but semantically passive, and it is rather characteristic of English, as illustrated in the following sentences: *The door doesn't lock. The jar won't open. Our car drives easily. The book reads well.*

As is apparent, mediopassives are largely based on whether it is possible or easy to do something, expressed either using the verbs *cannot*, *does not*, *will not*, or adverbs such as *easily*, *well*, and similar. Other languages including Czech do not form mediopassive structures and instead use reflexive passive forms to express an equivalent.

Oxford Learner's Dictionary (Eastwood, 2005) also adds that some idiomatic expressions with the auxiliary verb *to get*, such as *get washed* or *get married* (as mentioned in section 1.4), can retain their passive meaning even when used in the form of active infinitives: *There wasn't enough time to wash and change / to get washed and changed.*

Dušková (2006) then notes that an active present participle form after the verb *need* also carries a passive meaning, for example in the phrase *the windows need cleaning*. A passive infinitive of the same verb can be used instead of the active participle with no change in meaning: *the windows need to be cleaned*. In Czech, the usage is very similar with the difference that need is followed by an infinitive instead.

Occasionally, general verbs and adverbs can be used in the active voice as well while still indicating the passivity of the utterance. For instance: *The tickets are selling poorly. The battery is draining fast. The soup is already cooking.*

Furthermore, Swan (2016) demonstrates that there are active verbs that exclusively have a passive meaning. For example, we can say that *Lucy received a present*. Yet, the agent of the sentence is clearly someone who gave the present to Lucy, while she is, in fact, the patient. Dušková (2006) then adds that such a verb cannot form a passive structure in its passive meaning, but it can still have other, active meanings.

A similar phenomenon occurs with phrases such as *the car leaks oil* or *he burst a blood vessel*, where the subject is neither the agent nor the patient but rather an adverbial of place describing where the event happened. These phrases do not allow for a passive construction and can only be translated into Czech in their standard form, as an intransitive verb with an adverbial. (Dušková, 2006)

3. STYLISTIC ASPECTS OF THE PASSIVE VOICE

This chapter briefly describes how passives are utilized in the style of science and technology as opposed to conversational style. The style of science and technology is then characterized, and lastly, some arguments against the excessive use of passives in scientific discourse are presented.

3.1 Why and when to use the passive voice

Passives are not used equally in all functional styles, and their frequency is high especially in technical and scientific discourse. Nonetheless, the active voice usually comprises the majority of verbal structures, often with inanimate subjects. Meanwhile, conversational style typically employs the active voice almost exclusively. The difference between the two styles does not lie only in the quantity of passives, but also in the types used.

Passive constructions can be considered more complex, with a longer thought process required to form them, which is not ideal in a conversation. But when it is used, Dušková (2006) explains, its subject is usually animate, and the subject's emotional or mental state is often expressed with phrases like *she was overwhelmed with grief*. Passives are also often used in instructions and imperative phrases such as: *He is not to be trusted. You are requested to leave the room.*

It is not very common in English to include the agent in a passive sentence. When this happens, it is typically motivated by the need to change the word order and to shift emphasis in the sentence (so-called 'weight management'), as has already been explained. (Dušková, 2006) On the other hand, Knittlová (1990) points out that there are also occasions when an active construction is preferred even in scientific style, because it provides the desired word order.

3.1.1 The style of science and technology

The style of science and technology is most frequently actualized in written form similar to administrative style, and it is primarily monologic. (Knittlová, 2000) The main function of scientific style is to convey objective information from various fields of science in an accurate, apt, and complete way, despite the lack of feedback and situational context.

Knittlová (1990) explains that to ensure proper interpretation by the reader, scientific authors need to explain some of the specialized terminology involved and to keep their discourse clear and well-structured with the frequent use of linking words, demonstratives, and subordinating conjunctions. "Logical succession of facts given is respected so that the information could be understood without ambiguity." (Krhutová, 2007, p. 15) As a result, syntax tends to be very objective and monotonous, and the vocabulary is repetitive. (Knittlová, 1990)

The passive voice provides writers with several possibilities to organize their discourse logically and to make it objective and efficient. Longman Grammar of Spoken and Written English states:

> "Primarily the passive serves the discourse functions of:
> • cohesion and contextual fit through
> ordering of information
> omission of information (especially short passive)
> • weight management (especially in long passive)." (Biber et al., 1999, p. 935)

As Dušková (2006) explains, the possibility to omit the agent is especially advantageous in discourse that serves to transmit factual, objective information. Technical writers therefore often omit the agents of passive structures to imply a generic agent, or they use so-called 'authorial passive' to direct readers' attention to the subject matter.

Knittlová (1990) also notes that it is possible to use active forms with the general subject *we*, which refers to the author more clearly, but the general subject *one* is very rare in the English scientific style. As Swan summarizes: "Academic writing is most often impersonal, so for example the authors or researchers may not often appear as subjects of sentences. Passive structures are common." (2016, p. 288)

3.2 Arguments against using the passive voice

There are, however, such linguists that oppose certain aspects of the traditional conventions of academic style. Matthew Stevens (2007) argues that: "The convoluted passive sentences written in the third person that suggest that the work did itself obscure the reality of science. The actor is not only important, he or she is essential." (p. 1)

Despite science's need for efficiency and pure factuality, he urges editors and authors to enliven their discourse and "celebrate the pinnacle of human achievement that is science". (p. 1) This is understandable, because as serious and objective as scientific work may be, it is still done by people who deserve recognition for their endeavor. That is not to say that passive structures should not be used, but neither should the active voice be completely shunned for the sole purpose of complying with a general rule of academic style.

Also Russey, Ebel, and Bliefert (2006) remark that in scientific works, the usage of first-person verb forms alongside passives is increasingly common, as they "unquestionably add life to their surroundings" (Russey et al., 2006, p. 84). Regarding this growing trend, they argue that "the authors responsible are suggesting (or admitting) in a subtle way (perhaps unconsciously!) that the parties involved in conducting a scholarly investigation may themselves play a more than passive role" (Russey et al., 2006, p. 84).

Furthermore, active structures may not only sound more natural but can also be more comprehensible and informative. When a sentence is converted into the passive voice, the changes in its form and content "can cause ambiguity by submerging responsibility for an action when a more open approach would be clearer and fairer to readers." (The State of Victoria, 2006, p. 6) Exclusive usage of passives can be limiting for the author because English, due to its fixed word order, inevitably arranges the content in a sequence which might not always be beneficial for proper coherence and interpretation.

4. TRANSLATION OF PASSIVE STRUCTURES

This chapter outlines the intricacies that ought to be considered when translating passive structures from English into Czech.

It is essential in translation to understand how different the source and target language are, not only in terms of semantics and grammar but also stylistics. With the intensifying influence of English in the field of science, one may be tempted to translate technical texts mechanically, neglecting the stylistic adaptations necessary to make the discourse pleasant to read and easy to understand in the target language. Even though the frequency of passive structures in Czech scientific and administrative texts is higher than in casual speech, it is still not quite as common as in English and other Germanic languages, so retaining all passives in the translated text may not be tolerable. (Vlková, 2020)

The active voice is usually preferable in Czech, as Vlková (2020) states, often with a general unexpressed subject or with an indefinite pronoun acting as the subject. The overuse of passives can lead to an unnatural and overly impersonal impression, which is not desired in Czech, and may even evoke a feeling that the author is trying to obscure reality and evade responsibility for the actions described.

Besides the frequency of passive structures, Vlková (2020) also maintains that it is crucial to factor in the existence of two kinds of Czech passives, compound passives and reflexive passives, which cannot always be used interchangeably. Because there is no equivalent reflexive passive in English, translators tend to prioritize compound passives even when describing actions and processes rather than the resulting states.

To achieve an appropriate translation, it should be established why the passive voice was used in the first place. In English, the use of passives is often motivated purely by the need to change the word order, which is not a problem for the Czech language regardless of the grammatical voice. Similarly, authorial passives in technical texts can often be translated using the active voice in the first-person plural with an unexpressed subject. Alternatively, the subject can be a proper noun that fits the given context, such as *team*, *researchers*, or *colleagues*. On the other hand, if the agent is omitted because it is not known or it is clear from the context, the unexpressed subject *they* or the indefinite pronoun *someone* may be used, for example. (Behún, 2018)

Nonetheless, passive constructions have their place in Czech, and should not be avoided completely. While reflexive passives are common even in conversational style, compound passives can be useful especially in administrative texts.

5. ENGLISH FOR SPECIFIC PURPOSES

One of the aims of this thesis is to analyze the usage of passive voice structures in different genres of English for specific purposes (ESP) and to compare it with the usage in similar Czech texts. Besides the grammatical voice and the style of science and technology, it is therefore also necessary to define ESP and to examine its features.

Situated within English as a second or foreign language, English for specific purposes refers to teaching English to students or workers in a particular field. Instead of general vocabulary and grammar, the content of such language courses and study materials is focused on the specific needs of the learners and related to their disciplines, each of which can be very complex and broad in scope. This can typically include the language of science and technology, medicine, law, business, but also academic or vocational language. (de Chazal, 2014)

The concept of ESP began developing in different parts of the world in the 1960s, besides the UK and the USA, in various European and Asian countries where English was the primary language of university education. "Branching out from ESP were different, broadly grouped English-for-specific-purposes sectors, notably English for science and technology (EST), English for occupational purposes (EOP) and English for academic purposes (EAP). EAP was a product of the 1970s with the rise in the number of students whose first language was not English studying at universities. . . . This phenomenon has grown steadily ever since as increasing numbers of students seek to study in English-medium institutions worldwide, particularly universities." (de Chazal, 2014, p. 5) EAP and EOP can be classified as branches of ESP and both are principally focused on the learners' need to operate and communicate effectively in their respective fields and roles.

In 1988, Peter Strevens, an influential linguist and educationist, described ESP using four absolute and two variable characteristics:

Absolute characteristics:

ESP consists of English language teaching which is:

- designed to meet specified needs of the learner,
- related in content (i.e., in its themes and topics) to particular disciplines, occupations and activities,
- centered on the language appropriate to those activities in syntax, lexis, discourse, semantics, etc., and analysis of this discourse,
- in contrast with "General English".

Variable characteristics:

ESP may be, but is not necessarily:

- restricted as to the language skills to be learned (e.g., reading only),
- not taught according to any preordained methodology.

Claims:

The claims for ESP are:

- being focused on the learner's need, wastes no time,
- is relevant to the learner,
- is successful in imparting learning,
- is more cost-effective than "General English".

(Strevens, 1988, pp. 1–2, as cited in Johns & Dudley-Evans, 1991)

Subsequently, Dudley-Evans and St John (1998) further developed this definition:

Absolute characteristics:

- ESP is designed to meet specific needs of the learner;
- ESP makes use of the underlying methodology and activities of the disciplines it serves;
- ESP is centered on the language (grammar, lexis, register), skills, discourse and genres appropriate to these activities.

Variable characteristics

- ESP may be related to or designed for specific disciplines;
- ESP may use, in specific teaching situations, a different methodology from that of General English;
- ESP is likely to be designed for adult learners, either at a tertiary level institution or in a professional work situation. It could, however, be for learners at secondary school level;
- ESP is generally designed for intermediate or advanced students. Most ESP courses assume basic knowledge of the language system, but it can be used with beginners.

(Dudley-Evans & St John, 1998, pp. 4–5)

There have been attempts to introduce a strict division of ESP into English for academic purposes and English for occupational purposes and further into individual purposes and types using a tree diagram. However, Dudley-Evans and St John argue: "The use of classification trees creates a number of problems by failing to capture the essentially fluid nature of the various types of ESP teaching and the degree of overlap between 'common-core' EAP or EBP and General English." (1998, p. 8) They therefore suggest that English language courses should rather be presented on a continuum raging from General English to very specific ESP courses.

The key feature of ESP is needs analysis, which determines the course content and the ways in which teaching takes place. This encompasses mainly the target situation and objective needs, but also the learners' proficiency in English as well as their subjective needs and wants. (Dudley-Evans & St John, 1998)

6. ANALYSIS OF TEXTS

In this chapter, three pairs of English and Czech texts will be analyzed and compared with each other in terms of the frequency, types, and functions of passive voice structures. This serves to confirm the theoretical presumptions and to illustrate the differences in the usage of the grammatical voice in different genres of English technical texts and in the two languages. The genres of ESP chosen for analysis are popular scientific prose, didactic scientific prose, and academic scientific prose, represented by a popular-scientific article, a textbook excerpt, and a part of a doctoral thesis, respectively.

To summarize, it is presumed that the frequency of passives is noticeably higher in genres that require more objectivity and impersonality, meaning that a thesis should use passives the most and a popular scientific article the least. In terms of languages, the English texts are expected to use the passive voice more frequently than the Czech ones and while English is restricted to compound passives, reflexive passives are likely to be prominent in Czech. Furthermore, the occurrence of informal structures using the auxiliary verb *to get* or the phrase *to have something done* is unlikely in these texts. On the other hand, passive participles used as postmodifiers of nouns are likely to be used frequently as a means of condensation, and passive infinitives or gerunds may appear too.

6.1 Popular-scientific articles

The first pair of texts belongs to popular-scientific style as well as journalistic style because, besides explaining the topic, they serve to inform the general public and enthusiasts about new discoveries and advancements in the given field. The content of the two articles is nearly identical because they both inform readers about the developments in LiDAR technology achieved by British researchers at the University of Southampton. The English text was published on the website of the university, while the Czech one, written by Petr Kostolník, appeared in the popular-scientific magazine *Robotic journal*, and both are partly based on a story published in the journal Nature.

The first paragraph of each article summarizes that the researchers developed a new type of 3D LiDAR. Then it is explained what traditional LiDARs are used for and what their limitations are, and subsequently, the achievements of the researchers are described in detail, with the advantages of their new technology and the possible future development, including some quotations of the experts involved.

It is expected that these articles will contain relatively few passive voice structures and that their number will be even lower in the Czech text. Popular-scientific articles typically try to attract and engage the reader, so it seems likely that achieving impersonality and high objectivity will not be the primary function of passives. Instead, they may be used to organize information logically, to omit the agent when it is unknown or obvious, and to facilitate condensation.

6.1.1 English article analysis

Including its title and excluding the captions of images, the English article contains 47 verb forms overall, out of which only 6 are passive. That equals to approximately 13% of the verbs being passive. The number of finite verb forms is 33, with 31 active and 2 passive voice structures. The remaining 14 verb forms are non-finite, with 10 active ones and 4 passive ones.

The finite passive forms are *is used* and *can be addressed*, both of which are monotransitive verbs in the present simple. The non-finite passive forms include *used*, *needed*, *published*, and *faced*, all of which are passive participles.

In terms of stylistics, there seem to be only two functions of passive structures involved. The finite forms *is used* and *can be addressed* both imply an unspecified general agent such as *developers*, and it would therefore not be desirable to use the active voice. The non-finite passive participles then all stand as postmodifiers of nouns, functioning as a shorter alternative to a that-phrase. Furthermore, the passives help order information logically and provide cohesion.

6.1.2 Czech article analysis

The Czech article contains 33 verb forms, out of which 31 are active and 2 passive. This exactly corresponds with the number of finite verb forms in the English text. 6% of the verbs are therefore passive.

The first passive form *byly omezeny* is a compound passive in the past tense. It implies no animate agent as the systems mentioned were not limited deliberately but rather by the technology available at the time. It would therefore not be possible to use the active voice in this case without substantial changes.

The second verb *je uznáváno* can be found in the translated quotation of Graham Reed and implies a general animate agent whose identification is not crucial. Comparing this sentence with the English text however, it can be noticed that the Czech writer deliberately added this compound passive although it is not present in the original statement, and it is not clear why this decision was made. The English quotation uses the active voice with the subject *experts*.

6.2 Textbooks

The second pair of texts are excerpts from engineering textbooks for university students, covering the subject of feedback and control systems. They are written in the didactic scientific prose style, which aspires to make readers understand the given topic and to develop their knowledge and skills. “It mainly serves educational purposes. Its approach to the reader is somewhere between academic and popular scientific prose style.” (Zmrzlá, 2022, p. 70) As opposed to academic scientific prose, textbooks are not necessarily impersonal and purely objective, so they may often use the first-person plural subject *we* to make the reader, a student, feel included.

The English text, from the book *Feedback systems: An Introduction for Scientists and Engineers* written by K. J. Åström and R. M. Murray, is an introduction to the design of dynamics as a part of a feedback control system, highlighting their purpose and importance. This is exemplified with a quote by Wilbur Wright from 1901, a subsequent commentary, and the summarized history of the design of dynamics in the first aircrafts.

The Czech text, taken from *Řízení a regulace I: Základy regulace lineárních systémů* by P. Blaha and P. Vavřín, is concerned with regulators. Although it is also an introduction to the topic, the Czech text is more focused on explaining the concept itself rather than its importance and background. Specialized terminology appears frequently. The text explains what a regulator is, what it consists of, and how it functions, different types of regulators are described, and their typical structure is referred to.

A higher frequency of passives can be expected, compared to popular-scientific articles, used either to organize information in the text and focus on the subject matter, to omit general or unessential agents, or to provide condensation. Again, a smaller number of passives should be observed in the Czech text.

6.2.1 English text analysis

The total number of verb forms in the chosen English textbook extract is 71, with 61 active structures and 10 passive ones. The ratio of passives is therefore 14%. There are 48 finite forms, 41 of which are active, while 7 are passive. From the 23 non-finite forms, 20 are active, and 3 passive.

Firstly, there are three instances of the passive voice in one sentence, all in the same verbal form with the auxiliary verb *can* and implying a general agent. In terms of cohesion, this can be considered a parallelism, as the three successive clauses repeat the same word order and words (*systems that . . . can be . . .*). These are general statements, and the general agent therefore cannot be identified, which, together with cohesion, motivates the use of passives.

The non-finite participle *presented* is a noun modifier which condenses the sentence, and in the next paragraph, the passive participle *driven* is then used in a subordinate clause without its auxiliary verb. It relates back to its subject *wings*, which is an object in the main clause and also helps condense the sentence.

The subsequent two finite passive structures, *has been worked out* and *could not be brought up*, differ in their tense and modality, but they are both phrasal verbs and both imply a general agent. Then, the passive participle *invented* is used in an adjective clause with the subordinating pronoun *which* and the auxiliary *was* being omitted. Together with *was based*, the verb of the main clause, these two passives provide objectivity by focusing on the device rather than its inventor.

The last passive construction is the finite verb *can be used* followed by an active infinitive *to stabilize* and again, it implies a general agent as it is a general statement.

Throughout this extract, the subject *we* is used only once, in the second sentence, but it may appear more frequently in other parts of the textbook.

6.2.2 Czech text analysis

The Czech textbook excerpt contains 55 verbs, 9 of which are passive forms and 46 are active forms, however, two of them imply a passive meaning. Passives constitute 16% of the verb forms in the text.

There are three instances of compound passives, *je složen*, je *nakreslena*, and *nejsou užívány*. The first structure implies no agent, solely stating what a regulator *is composed* of, and neither does the second, although it may be argued that the agent is the person who created the mentioned figure. The third compound passive then implies a general animate agent and could easily be replaced with a reflexive passive.

Speaking of reflexive passives, these are the remaining six passive constructions *se používají*, *jedná se*, *se musí zajistit*, *se provádí*, *se volí*, and *označuje se*. Their function is to facilitate general objective statements about the topic implying a general agent, although *jedná se o* is more of a fixed passive phrase referring to the preceding sentence. In this case could be translated as *these are*. Reflexive passives are not to be confused with reflective active verbs such as *zabýváme se*, *projeví se*, or *seznámíte se*.

In terms of active structures, the first-person plural subject (although unexpressed) is used 10 times in this text, two of which apparently refer only to the authors and not the readers. Furthermore, the readers are directly addressed with the second-person plural subject (again unexpressed) when it is stated that they will become acquainted with the wind-up effect later in their studies. There are also two active verb forms indicating a passive meaning due to their unexpressed indefinite third-person subject. These are *lze dokázat* and *lze transformovat*, which could be translated as *can be proved* and *can be transformed*, respectively. This type of active structures is quite appropriate in Czech while the use of compound passives would sound unnatural, as mentioned in chapter 4.

6.3 Doctoral theses

The texts chosen as the ones requiring the highest level of objectivity and impersonality are doctoral theses written in the academic scientific prose style. “Its main purpose is to inform the reader . . . in the most exact way, and its literary qualities are not relevant at all. The main language function is referential (or expressive). The sender does not need to attract the receiver. Lexically it is characterized by extreme density, which sometimes makes it difficult to follow.” (Zmrzlá, 2022, p. 70)

The English extract comes from an MIT doctoral thesis written in 2021 by Joseph DelPreto, *Robots as Minions, Sidekicks, and Apprentices: Using Wearable Muscle, Brain, and Motion Sensors for Plug-and-Play Human-Robot Interaction*. It is a part of the chapter *Experimental Paradigm and Methodology* divided into three sections.

The Czech doctoral thesis, from BUT, also focuses on the field of robotics and describes the possibilities of localization for mobile robots. It was written by Tomáš Neužil in 2008 with the title *Průběžná lokalizace a mapování pomocí mobilního robotu*. The text is a part of the chapter *Lokalizace v robotice* and it is divided into three sections.

Passives should be frequent, keeping the discourse purely objective, ordering it logically, and facilitating coherence. Active structures are likely to have mostly inanimate subjects.

6.3.1 English text analysis

The English text contains 70 verb forms in total, 48 of them are active ones while 22 are passive. That means 31% of verbs are passive voice structures. In terms of finite forms, 35 out of 55 use the active voice and 20 the passive voice.

There are only two non-finite passive forms, the passive participles *shown* and *used*. While *used* is a postmodifier of a noun, which condenses the sentence, *shown* omits its auxiliary verb because it is used in the fixed phrase *as shown in* and refers to the preceding clause. Although active structures are still more frequent than passive ones, the text is very impersonal because animate subjects are used scarcely, such as *human*, *subjects*, *individuals*, and *participants*.

Except for *was approved*, all passive structures omit their agents, either to imply a general agent or to avoid an unimportant or obvious agent, such as the robot, the experimental system, or the author himself. This helps the text focus on objective matters. The verbs that likely imply the author as the agent are *was trained*, *was used*, *was performed*, *was divided*, *is presented*, *is excluded*, *were recruited*, *were selected*, *were not screened*, *was separated*, and *were conducted*. All passive verbs are used in the present simple or past simple tense with no distinct or unusual features, and only two of them use the modal verb *may*.

6.3.2 Czech text analysis

The Czech excerpt contains 44 verb forms, out of which 30 are active and 14 are passive. This means the passive voice is used in 32% of the verbs.

Passive voice structures mostly imply general agents because the author describes not his actions but the theoretical concepts of the topic. They help structure the text and keep it cohesive. There are 10 compound passives, including *je označována*, *jsou využívány*, *mohou být vytvořeny*, or *byly navrženy a vytvořeny*. Unlike in the didactic text, compound passives are more frequent here, while the four reflexive passives present are *se využívají*, *se soustředí*, *se využívá*, and *se integruje*.

Although *soustředit se* can be a reflexive active verb as well, in this case it is used with an inanimate subject as a reflexive passive. The active verb *lze* is again used here, which could be translated as a passive into English.

6.4 Analysis summary

To summarize the results of the analysis, the frequency of passive structures was, indeed, the lowest in the chosen popular-scientific articles and the highest in the doctoral theses. In terms of languages, however, the total ratio of passives to all verb forms was not distinctly and consistently higher in the chosen English texts compared with the Czech ones. Only the popular-scientific articles seem to fulfil this expectation.

Even when comparing finite forms only, the overall outcome does not change significantly. It is only when the share of compound passive forms is considered (excluding reflexive passives) that the resulting frequency of passives is consistently higher in English.

It can therefore be concluded that in the sample of texts chosen for analysis, the frequency of passive voice structures is comparable in English and in Czech, however, the usage of compound passives in Czech is substantially less frequent. The following table shows the respective percentages of verb forms which are passive in each of the analyzed texts.

Genre	Share of passive verbs			
	English in total	English in finite forms	Czech in total	Czech compound forms
Popular scientific	13%	6%	6%	6%
Didactic scientific	14%	15%	16%	5%
Academic scientific	31%	36%	32%	23%

7. CONCLUSION

The aim of this paper was to extensively describe the topic of passive voice structures and to compare their usage in different genres of ESP and in English compared with Czech. Based on the research of the listed literature, the rules and functions, the possibilities and limitations, as well as the specifics and intricacies of the usage of the passive voice were described from multiple linguistic perspectives. Subsequently, the occurrence of passives was analyzed in three technical English texts and similar Czech texts to illustrate the differences in their usage in different genres and languages.

To provide a better understanding of the subject, terms such as *agent*, *patient*, *theme*, and *rheme* were explained within the first chapter, together with the topic of verb transitiveness. The explication of grammar and semantics covered not only the basic forms of passives in English but also passive infinitives and gerunds, double passives, semi-passives and pseudo-passives, active forms with passive meaning, and the passive forms used in the Czech language.

The passive voice provides more variability in terms of word order and weight management with the possibility to omit the agent and further organize the text to achieve cohesion. Its usage is therefore prominent and often very convenient in the style of science and technology and in administrative style, which ought to be highly objective, logical, and impersonal. When translating texts into Czech or other Slavic languages, however, it is necessary to employ more reflexive passives and active voice since compound passives naturally tend to appear less frequently.

Before the analysis of texts, the concept of English for specific purposes was briefly described in contrast with general English courses. To outline its characteristics, the definitions established by Strevens and Dudley-Evans were presented. Finally, three written texts were chosen, representing genres of ESP with different levels of objectivity and impersonality required, and each accompanied by a similar Czech text.

Based on the research of specialized literature, it was expected that the frequency of passive voice structures would increase with the required objectivity of each genre and that it would be higher in English texts compared with equivalent Czech texts. The analysis itself then proved the former to be true in both English and Czech. The occurrence of passives was the lowest in the popular-scientific articles, while in the doctoral theses it was the highest. Concerning the latter expectation, however, in the chosen sample of texts, the frequency of passives was very similar in Czech and in English, and only compound passives were distinctly more common in English.

Although languages constantly develop and influence each other, it seems unlikely for the linguists' claims to be already outdated. This unexpected outcome was probably caused by the choice of texts and the results may have differed even if other excerpts from the same textbooks and theses were chosen. To acquire reliable, unbiased data, it would

be necessary to inspect much larger amounts of texts such as whole magazines, textbooks, and theses from different fields of ESP, which is beyond the scope of this paper.

Besides the fact that the analyzed texts all came from the field of electrical engineering, another limitation of this paper is that it did not analyze any spoken genres of ESP, such as a lecture, a presentation, or a discussion. Future research could therefore focus on the quantitative analysis of longer written and spoken texts from a variety of fields including medicine, law, or business. Alternatively, the frequency of passives in Czech texts could be analyzed in relation to the year of publication to find out whether the usage of passive voice is increasing in Czech technical texts, perhaps under the influence of English as a lingua franca.

LITERATURE

[1] Åström, K. J. & Murray, R. M. (2020). *Feedback systems: An Introduction for Scientists and Engineers* (2nd ed.) [electronic version v3.1.5], 1-15–1-16. Princeton University Press.

[2] Behún, P. (2018). *TRPNÝ ROD – 3. díl: Jak ho v textu omezit* [online]. Proofreading.cz. Accessed November 30, 2021. Retrieved from https://proofreading.cz/trpny-rod-3-dil-jak-ho-v-textu-omezit/

[3] Biber, D., Johansson, S., Leech, G., Conrad, S., & Finegan, E. (1999). *Longman Grammar of Spoken and Written English.* Pearson Education Limited. ISBN 0 582 237254

[4] Blaha, P. & Vavřín, P. (2019). *Řízení a regulace I: Základy regulace lineárních systémů* [electronic version v. 1.3.9], 44. Vysoké učení technické v Brně.

[5] Chalker, S. & Weiner, E. (1994). *The Oxford Dictionary of English Grammar*. Clarendon Press. ISBN 0-19-861242-7

[6] Crystal, D. (2005). *How Language Works*. Penguin Books. ISBN 978-0-140-51538-1

[7] de Chazal, E. (2014). *English for Academic Purposes.* Oxford University Press. ISBN 978 0 19 442371 7

[8] DelPreto, J. (2021). Robots as Minions, Sidekicks, and Apprentices: Using Wearable Muscle, Brain, and Motion Sensors for Plug-and-Play Human-Robot Interaction, 164–166. Massachusetts Institute of Technology. https://hdl.handle.net/1721.1/139997

[9] Dušková, L., et al. (2006). *Mluvnice současné angličtiny na pozadí češtiny* (3rd ed.). Academia. ISBN 80-200-1413-6.

[10] Eastwood, J. (2005). *Oxford Learner's Grammar: Grammar Finder*. Oxford University Press. ISBN 978 0 19 437593 5

[11] Knittlová, D. (1990). *Funkční styly v angličtině a češtině* (2nd ed.). Univerzita Palackého, Filozofická fakulta.

[12] Knittlová, D. (2000). *K teorii a praxi překladu*. Univerzita Palackého v Olomouci, Filozofická fakulta. ISBN 80-244-0143-6

[13] Kostolník, P. (2021). Lidar založený na křemíkové fotonice. *Robotic journal*, *6*(1), 23. https://www.roboticjournal.cz/

[14] Krhutová, M. (2007). *The Language of Electrical Engineering as a Special Province*. AKADEMICKÉ NAKLADATELSTVÍ CERM®, s.r.o. ISBN 978-80-7204-562-4

[15] Neužil, T. (2008). *Průběžná lokalizace a mapování pomocí mobilního robotu*, 18–19. Vysoké učení technické. https://www.vut.cz/www_base/zav_prace_soubor_verejne.php?file_id=4329

[16] Russey, W. E., Ebel, H. F., & Bliefert, C. (2006). *How to Write a Successful Science Thesis*. WILEY-VCH Verlag GmbH & Co. KGaA. ISBN 3-527-31298-6

[17] Stevens, M. (2007). *Subtleties of Scientific Style*. ScienceScape® Editing. ISBN 0 9578877 2 8.
[18] Swan, M. (2016). *Practical English Usage* (4th ed.). Oxford University Press. ISBN 978 0 19 420246 6
[19] The State of Victoria. (2006). *The Good Writing Guide* [online]. Department of Primary Industries. Accessed October 24, 2021. Retrieved from https://www.vgls.vic.gov.au/client/en_AU/search/asset/1011943/0.
[20] Vlková, V. (2020, February 28). *Malý průvodce džunglí slovesných tvarů (22)* [online]. Odborné časopisy. Accessed November 29, 2021. Retrieved from http://www.odbornecasopisy.cz/elektro/clanek/maly-pruvodce-dzungli-slovesnych-tvaru-22--5200
[21] University of Southampton. (2021). *Silicon chip provides low cost solution to help machines see the world clearly* [online]. University of Southampton. Accessed April 28, 2022. Retrieved from https://www.southampton.ac.uk/news/2021/02/compact-lidar-chip.page
[22] Widdowson, H. G. (2004). *Text, Context, Pretext*. Blackwell Publishing. ISBN-0-631-23451-9
[23] Zmrzlá, P. (2022). *Discourse under Investigation: A brief summary of theoretical background and concepts.* Vysoké učení technické v Brně. ISBN 978-80-214-6056-0

LIST OF APPENDICES

Appendix A - Popular-scientific articles

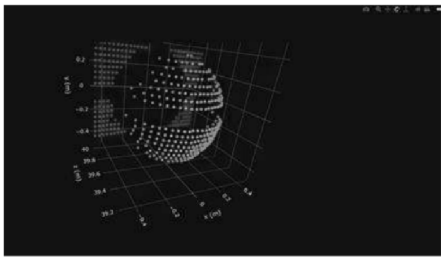
A.1 Silicon chip provides low cost solution to help machines see the world clearly

> News >

Silicon chip provides low cost solution to help machines see the world clearly

Back to top

Published: 10 February 2021



Researchers in Southampton and San Francisco have developed the first compact 3D LiDAR imaging system that can match and exceed the performance and accuracy of most advanced, mechanical systems currently used.

3D LiDAR can provide accurate imaging and mapping for many applications; it is the "eyes" for autonomous cars and is used in facial recognition software and by autonomous robots and drones. Accurate imaging is essential for machines to map and interact with the physical world but the size and costs of the technology currently needed has limited LIDAR's use in commercial applications.

Exercise ball & screen at 40m - picture taken using a 32x16 pixel sensor (2mmx2.5mm sensor size)

Now a team of researchers from Pointcloud Inc in San Francisco and the University of Southampton's Optoelectronic Research Centre (ORC) have developed a new, integrated system, which uses silicon photonic components and CMOS electronic circuits in the same microchip. The prototype they have developed would be a low-cost solution and could pave the way to large volume production of low-cost, compact and high-performance 3D imaging cameras for use in robotics, autonomous navigation systems, mapping of building sites to increase safety and in healthcare.

Graham Reed, Professor of Silicon Photonics within the ORC said, "LIDAR has been promising a lot but has not always delivered on its potential in recent years because, although experts have recognised that integrated versions can scale down costs, the necessary performance has not been there. Until now.

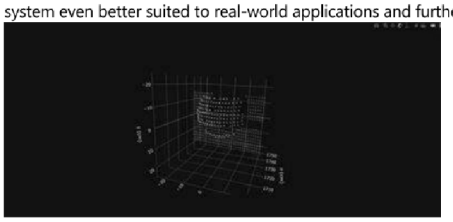
"The silicon photonics system we have developed provides much higher accuracy at distance compared to other chip-based LIDAR systems to date, and most mechanical versions, showing that the much sought-after integrated system for LIDAR is viable."

Remus Nicolaescu, the CEO of Pointcloud Inc added, "The combination of high performance and low cost manufacturing, will accelerate existing applications in autonomy and augmented reality, as well as open new directions, such as industrial and consumer digital twin applications requiring high depth accuracy, or preventive healthcare through remote behavioural and vital signs monitoring requiring high velocity accuracy.

"The collaboration with the world class team at the ORC has been instrumental, and greatly accelerated the technology development."

The latest tests of the prototype, published in the journal Nature, show that it has an accuracy of 3.1 millimetres at a distance of 75 metres.

Amongst the problems faced by previous integrated systems are the difficulties in providing a dense array of pixels that can be easily addressed; this has restricted them to fewer than 20 pixels whereas this new system is the first large-scale 2D coherent detector array consisting of 512 pixels. The research teams are now working to extend the pixels arrays and the beam steering technology to make the system even better suited to real-world applications and further improve performance.



Basketball & screen at 17m - picture taken using a 32x16 pixel sensor

Swivel chair & screen at 40m - picture taken with a 32x16 pixel sensor

University of Southampton. (2021). *Silicon chip provides low cost solution to help machines see the world clearly* [online]. University of Southampton. Accessed April 28, 2022. Retrieved from https://www.southampton.ac.uk/news/2021/02/compact-lidar-chip.page

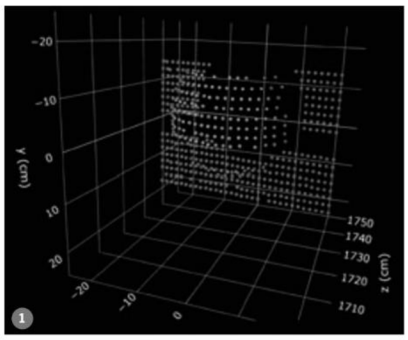
A.2 Lidar založený na křemíkové fotonice

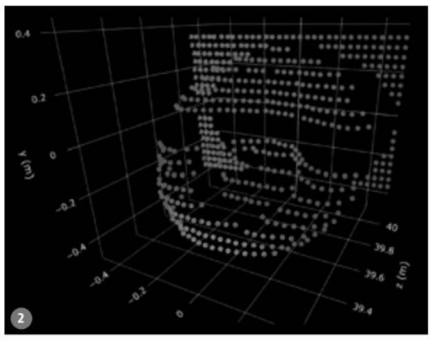
Robotic journal

Téma

LIDAR ZALOŽENÝ NA KŘEMÍKOVÉ FOTONICE

Vědci z britského Southamptonu vyvinuli lidarový senzor, který by mohl připravit cestu pro levné a vysoce výkonné 3D zobrazování.





1 Snímek basketbalového míče se zástěnou pořízený ze 17 metrů snímačem o rozměrech 32 x 16 px.

2 Snímek otočné židle se zástěnou pořízený na vzdálenost 40 metrů snímačem o rozměrech 32 x 16 px. Velikost snímače v obou případech byla 2 x 2,5 mm.

FOTO: PointCloud, ORC

Přesné prostorové zobrazování je pro stroje nezbytné pro mapování a interakci s fyzickým světem. Ačkoli existuje řada 3D zobrazovacích technologií, z nichž každá se s různým stupněm úspěchu zaměřuje na specializované aplikace, žádná nedosáhla šíře použitelnosti a dopadu, který mají digitální obrazové snímače v dvourozměrném zobrazování. Jako univerzální 3D zobrazovací platforma by však mohlo sloužit rozsáhlé dvourozměrné pole koherentních detektorů pixelů fungující jako systém detekce a měření vzdálenosti.

Vědci z Optoelektronického výzkumného centra (ORC) Southamptonské univerzity a sanfranciské firmy PointCloud demonstrovali v časopise Nature provoz rozsáhlé řady koherentních detektorů tvořených z 512 pixelů. Předchozí systémy založené na podobné technologii byly dosud omezeny na méně než 20 pixelů kvůli obtížím při zajišťování elektrického a fotonického připojení ke každému pixelu. Nová technologie lidar, kterou vytvořili, tak překračuje výkon a přesnost většiny současných mechanických systémů. Jejich čip využívá křemíkové fotonické komponenty v kombinaci s elektronickými obvody CMOS. Při použití 4 mW světla dosahuje přesnosti 3,1 mm na vzdálenost 75 m, což je podle vědců „řádově přesnější než stávající systémy v pevné fázi v takových rozsazích".

V současné době je lidar předmětem řady vývojových aktivit v automobilovém segmentu, protože jde o jednu z klíčových snímacích technologií pro autonomní řízení. V průmyslovém vidění fungují kamery typu time-of-flight na podobném principu jako lidar, ale bez skenování světelných pulsů. Podle výzkumníků je jejich technologie příslibem pro využití v robotice, autonomní navigaci, rozšířené realitě i zdravotnictví.

„Lidar zatím ne vždy využil svůj potenciál, ačkoli je uznáváno, že integrované verze mohou snížit náklady, nedosahovaly potřebné výkonové parametry. Až dosud. Silikonový fotonický systém, který jsme vyvinuli, poskytuje mnohem vyšší přesnost na dálku ve srovnání s jinými dostupnými systémy čipů založených na lidaru. Většina mechanických verzí ukazuje, že vyhledávaný integrovaný systém pro lidar je životaschopný," uvedl Graham Reed, profesor křemíkové fotoniky na ORC.

Nová technologie překračuje výkon a přesnost většiny současných mechanických systémů.

Kombinace vysokého výkonu a nízké výrobní ceny zrychlí stávající aplikace v oblasti autonomních systémů a rozšířené reality. Stejně tak může otevřít nové směry, jako jsou průmyslové a spotřebitelské digitální aplikace vyžadující vysokou hloubku přesnosti nebo v oblasti preventivní zdravotní péče prostřednictvím vzdáleného monitoringu životních funkcí.

Výzkumníci nyní pracují na rozšíření pixelových polí a technologii řízení paprsku pro další zlepšení výkonu. Budoucí zmenšení velikosti pixelu by podle nich mohlo přinést rozlišení přesahující 20 megapixelů pro pole o velikosti snímače používaného v běžném fotoaparátu. ■

Petr Kostolník

Kostolník, P. (2021). Lidar založený na křemíkové fotonice. *Robotic journal*, *6*(1), 23. https://www.roboticjournal.cz/

Appendix B - Textbooks

A.3 Design of Dynamics

Another use of feedback is to change the dynamics of a system. Through feedback, we can alter the behavior of a system to meet the needs of an application: systems that are unstable can be stabilized, systems that are sluggish can be made responsive, and systems that have drifting operating points can be held constant. Control theory provides a rich collection of techniques to analyze the stability and dynamic response of complex systems and to place bounds on the behavior of such systems by analyzing the gains of linear and nonlinear operators that describe their components.

An example of the use of control in the design of dynamics comes from the area of flight control. The following quote, from a lecture presented by Wilbur Wright to the Western Society of Engineers in 1901 [McF53], illustrates the role of control in the development of the airplane:

> Men already know how to construct wings or airplanes, which when driven through the air at sufficient speed, will not only sustain the weight of the wings themselves, but also that of the engine, and of the engineer as well. Men also know how to build engines and screws of sufficient lightness and power to drive these planes at sustaining speed ... Inability to balance and steer still confronts students of the flying problem ... When this one feature has been worked out, the age of flying will have arrived, for all other difficulties are of minor importance.

The Wright brothers thus realized that control was a key issue to enable flight. They resolved the compromise between stability and maneuverability by building an airplane, the Wright Flyer, that was unstable but maneuverable. The Flyer had a rudder in the front of the airplane, which made the plane very maneuverable. A disadvantage was the necessity for the pilot to keep adjusting the rudder to fly the plane: if the pilot let go of the stick, the plane would crash. Other early aviators tried to build stable airplanes. These would have been easier to fly, but because of their poor maneuverability they could not be brought up into the air. The Wright Brothers were well aware of the compromise between stability and maneuverability when they designed the Wright Flyer [Dra55] and they made the first successful flight at Kitty Hawk in 1903. Modern fighter airplanes are also unstable in certain flight regimes, such as take-off and landing.

Since it was quite tiresome to fly an unstable aircraft, there was strong motivation to find a mechanism that would stabilize an aircraft. Such a device, invented by Sperry, was based on the concept of feedback. Sperry used a gyro-stabilized pendulum to provide an indication of the vertical. He then arranged a feedback mechanism that would pull the stick to make the plane go up if it was pointing down, and vice versa. The Sperry autopilot was the first use of feedback in aeronautical engineering, and Sperry won a prize in a competition for the safest airplane in Paris in 1914. Figure 1.12 shows the Curtiss seaplane and the Sperry autopilot. The autopilot is a good example of how feedback can be used to stabilize an unstable system and hence “design the dynamics” of the aircraft.

Åström, K. J. & Murray, R. M. (2020). *Feedback systems: An Introduction for Scientists and Engineers* (2nd ed.) [electronic version v3.1.5], 1-15–1-16. Princeton University Press.

A.4 Regulátory

Regulátor působí pomocí akční veličiny na soustavu tak, aby regulační odchylka byla co nejmenší. V tomto širším smyslu je regulátor složen z celé řady dalších částí. Podle obrázku 1.3 je to nejen ústřední člen regulátoru, který určuje regulační zákon (též algoritmus řízení), ale i výkonový zesilovač, měřicí člen a převodník vstupní veličiny. Měřicí člen - čidlo - zahrnujeme nejčastěji do přenosu soustavy a výkonový zesilovač i vstupní převodník jsou z dynamického hlediska proporcionální členy. Z hlediska kvality regulace je nejdůležitější částí jeho ústřední člen. Ostatní členy mají víceméně standardní vlastnosti, dané konstrukčními principy a možnostmi. Proto pokud kreslíme blokové schéma regulačního obvodu v té nejjednodušší formě (obrázek 1.2), je středem našeho zájmu právě návrh ústředního členu.

V praxi se nejčastěji používají regulátory, které jsou složené ze tří základních složek. Jedná se o proporcionální, integrační a derivační složku. Tím vznikají různé typy jednoduchých regulátorů, až po PID regulátor. U regulátorů PD a PID se musí zajistit realizovatelnost, což se provádí použitím časové konstanty, která se většinou volí o dva řády nižší, než jsou časové konstanty v čitateli regulátoru.

V této kapitole se stejně jako v celém skriptu zabýváme pouze lineárními systémy, tedy lineárními regulátory. V praxi jsou bohužel všechny regulátory nelineární z důvodu omezení akčního zásahu. Omezení akčního zásahu ve spojení s I složkou regulátoru se nám nepříznivě projeví na prodloužení přechodného děje z důvodu wind-up efektu. O těchto problémech a jejich řešení se podrobně seznámíte v navazujících kurzech.

Uspořádání podle obrázku 1.2 (nebo obrázku 1.3) není jediná možná struktura zpětnovazební regulace, i když je nejčastější. Je to struktura typická pro systémy typu servomechanizmu, tedy případ vlečné regulace. V těchto případech je důležitý buď dokonalý přenos řídicí veličiny, zatímco kompenzace poruch, vzhledem k menší četnosti jejich výskytu, není tak podstatná, nebo je tomu naopak; důležitá je kompenzace poruch a přenos řídicí veličiny, s ohledem na to, že tato je po většinu doby konstantní, není podstatný. Společným znakem těchto systémů je to, že neklademe současně požadavky na obě základní funkce zpětnovazebního řídicího obvodu. Pak nám struktura podle obrázku 1.2 plně vyhoví. Protože můžeme splnit pouze jeden z několika možných požadavků, označuje se obvod na obrázku 1.2 jako regulační obvod s jedním stupněm volnosti. Požadavky na oba přenosy, řízení i poruchy, můžeme splnit daleko dokonaleji podle struktury, která je nakreslena na obrázku 4.1 a) nebo 4.1 b). Jak lze snadno dokázat, oba obvody jsou co do vlastností stejné a lze je navzájem transformovat. (Konkrétní přenosy Ra1, Ra2 a Rb1, Rb2 jsou ovšem rozdílné.) Blok VZ je výkonový zesilovač. Je třeba zdůraznit, že signál $\varepsilon(t)$ není totožný s regulační odchylkou $e(t) = w(t) - y(t)$. Obvody tohoto typu nazýváme se dvěma stupni volnosti, neboť umožňují současné splnění dvou skupin požadavků. Jejich realizace analogovými prostředky však je poněkud obtížná a nejsou proto běžně užívány. Zcela běžné jsou v případech číslicového řízení.

V následujících kapitolách tohoto skripta však budeme předpokládat uspořádání podle obrázku 1.2, tedy jediný sériový regulátor. Ve zvláštních případech změnu výslovně uvedeme. Ve shodě s obvyklou praxí také budeme pojem regulátor používat ve smyslu ústřední člen.

Blaha, P. & Vavřín, P. (2019). *Řízení a regulace I: Základy regulace lineárních systémů* [electronic version v. 1.3.9], 44. Vysoké učení technické v Brně.

Appendix C - Doctoral theses

A.5 Experimental Paradigm and Methodology

7.2.1.1 Closed-Loop Sessions

The subject's EEG signals were used to control the robot's behavior in real time. During these trials, the robot performed a two-stage reaching motion. The first stage is a lateral movement that conveys the robot's intended target and initiates the EEG classification system. The human mentally judges whether the indicated choice is correct, and the robot decides to continue toward the intended target or to switch to the other target based on whether an ErrP is detected. The second stage of the reaching motion is then a forward reach towards the updated target selection.

The robot selects its initial target with a bias towards choosing correctly – it has a 70% chance of choosing the correct target. This helps elicit an ErrP response from the supervisor, since ErrPs are stronger when the mistake is unexpected.

A full experimental session included 4 blocks of 50 trials. At the end of each block, a new classifier was trained with the data from the current session so far. The first block was used to collect initial training data, so no classification was performed; the controller randomly decided whether to inform the robot of an error on each trial. This can induce a secondary ErrP in the subjects that is evaluated in offline analysis. Online classification was used as closed-loop feedback for all blocks after the first. If a misclassification occurs, a secondary ErrP may be induced as shown in Figure 7-3 since the robot did not obey the human's feedback. This may be used in the future to cause another trajectory change and ultimately choose the correct target.

7.2.1.2 Open-Loop Sessions

During open-loop trials, no online classification was running while the robot performed the target selection. A one-stage reaching movement was used, in which the robot directly moved its arm from the starting position to its selected target. The subjects passively evaluated the robot's performance, and were aware that their EEG signals were not controlling it. In 7 out of 8 sessions, the robot had a uniform probability of selecting the correct target. In the remaining session, the robot had a 70% chance of choosing the correct target. Each experimental session was divided into 5 blocks of 50 trials. Data from these sessions was used during offline analysis to confirm the presence of the error-related potentials and to optimize parameters of the classifier used in the closed-loop sessions.

7.2.1.3 Subject Selection

A total of 12 individuals participated in the experiments (10 male, 11 right-handed). Of these, 7 participated in the open-loop paradigm (5 male, 6 right-handed), and 5 participated in the closed-loop paradigm (5 male, 5 right-handed). From the 5 subjects participating in the closed-loop paradigm, only data from 4 is presented; the last subject performed the task while in a meditative state, and for consistency is excluded from the current analysis.

Participants were recruited with community advertisements at Boston University and MIT. They were selected from the general population, and did not undergo any training sessions. Subjects were not screened based on their innate ability to produce ErrPs or their experience with brain-computer interfaces such as EEG systems.

All subjects provided informed consent for the study, which was approved by the Internal Review Board of Boston University and the Committee on the Use of Humans as Experimental Subjects of MIT. A typical session lasted approximately 1.5 hours including EEG cap preparation, and was separated into 4 or 5 blocks for closed-loop or open-loop sessions, respectively. Each block contained 50 trials and lasted 9 minutes. Experiments were conducted at the MIT Distributed Robotics Laboratory.

DelPreto, J. (2021). *Robots as Minions, Sidekicks, and Apprentices: Using Wearable Muscle, Brain, and Motion Sensors for Plug-and-Play Human-Robot Interaction*, 164–166. Massachusetts Institute of Technology. https://hdl.handle.net/1721.1/139997

A.6 Lokalizace v robotice

4.1 Sledování dráhy

Tyto robotické systémy se pohybují po předem dané trajektorii, kterou je senzorický systém mobilního robotu schopen detekovat. Tato navigační technika umožňuje použití poměrně jednoduchého senzorického systému a neklade zvláštní nároky na výpočetní výkon. Tato lokalizační metoda je v zahraniční literatuře označována jako Line Following. Nejčastěji využívanými typy drah jsou elektrické vodiče, kterými protéká střídavý elektrický proud, a ten je snímán pomocí cívky umístěné na mobilním robotu. Trajektorie mobilního robotu je předem dána uložením vodičů v podlaze a robot není schopen přesně určit vlastní polohu ve kterémkoliv okamžiku. Tento způsob lokalizace také vyžaduje zásah do prostředí (položení kabelů, namalování barevných pruhů, a pod.), což může být v některých případech nákladné nebo neproveditelné.

Přes uvedené nevýhody jsou tyto systémy využívány pro dopravu materiálu v automatizovaných provozech, nemocnicích a pod. V neposlední řadě se využívají také jako vhodná výuková úloha pro studenty kurzů robotiky a v disciplíně Path Follower jsou pořádány mezinárodní studentské soutěže. Příkladem může být soutěž Istrobot, pořádaná na TU Bratislava, ve které sledování dráhy tvoří jednu z disciplín [6].

V současné době se některá vědecká pracoviště začínají zabývat systémy pro sledování pachové stopy. Pachovou stopu využívají pro svoji orientaci zvířata a hmyz. Výzkum v této oblasti se soustředí na vývoj systému, který by umožňoval lokalizaci a mapování míst úniku jedovatých látek v nebezpečných prostředích [4, 13].

4.2 Odometrie, inerciální navigační systém

Další možnou metodou lokalizace mobilního robotu je odometrie, metoda využívající měření otáček kol robotu. Pro určení polohy robotu se využívá znalosti rozměrů kol a geometrického uspořádání podvozku. Tato metoda však nezahrnuje vlivy prostředí na robot jako jsou například prokluz kol, smýkání kol při zatáčení apod. a je využitelná pouze u kolových podvozků. Nezávislost na druhu robotického podvozku nabízí systém inerciální navigace, který pro určení polohy využívá měření zrychlení ve všech stupních volnosti a jejich následnou dvojí integraci.

Hlavní nevýhodou inerciálního navigačního systému je skutečnost, že s užitečnou informací, která odpovídá měřenému zrychlení, se integruje také chyba měření. Obě zmíněné metody jsou samostatně nepoužitelné z důvodů rostoucí chyby stanovované polohy robotu.

4.3 Lokalizace pomocí orientačních bodů

Orientační body (v anglické literatuře označované jako landmarks) jsou místa s charakteristickými rysy v pracovní oblasti mobilního robotu, která je robot schopen detekovat pomocí vlastních snímačů. Tyto oblasti mohou mít podobu geometrických útvarů, jako jsou čáry, kruhy, mnohoúhelníky apod., popřípadě mohou být vytvořeny

uměle, například formou rádiových vysílačů [12]. Základním předpokladem metody je neměnná poloha orientačních bodů během procesu lokalizace. Lokalizace pomocí orientačních bodů je v zahraniční literatuře označována jako Beacon Navigation. Orientační body lze rozdělit do následujících skupin:

přirozené orientační body orientační body, které byly vytvořeny za jiným účelem než je navigace robotu. Typickým příkladem jsou: rohy místností, dlouhé chodby, okna atd.,

umělé orientační body orientační body, které byly navrženy a vytvořeny pouze za účelem navigace robotu. Typickým příkladem jsou černobílé obrazce (kamerové navigační systémy), terče s vysokou odrazivostí (optické laserové systémy), aktivních vysílačů (rádiové systémy),

aktivní orientační body vysílače, které vysílají signál umožňující stanovení polohy robotu (vysílače GPS),

pasivní orientační body odražeče, terče s definovanými rozměry a pod.

Neužil, T. (2008). *Průběžná lokalizace a mapování pomocí mobilního robotu*, 18–19. Vysoké učení technické.
https://www.vut.cz/www_base/zav_prace_soubor_verejne.php?file_id=4329