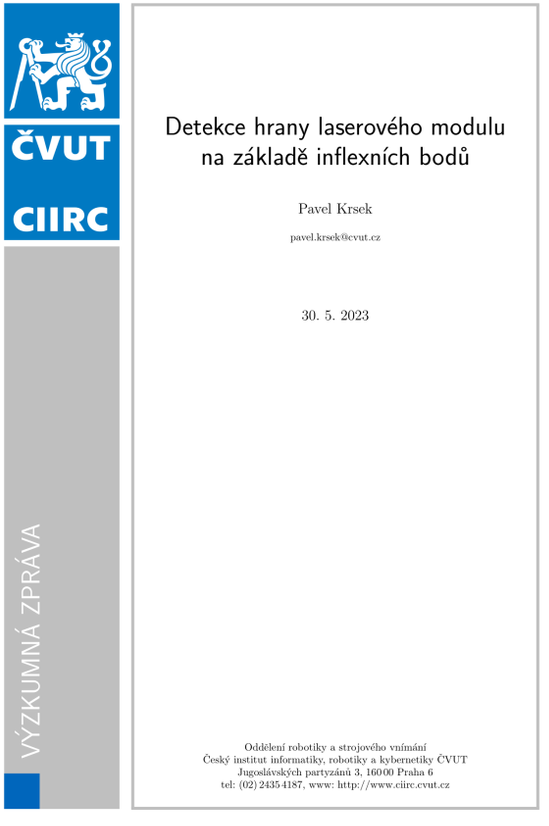
Technical Report

(bachelor and diploma thesis)

The form and factual content of the report

Pavel Krsek, March 2024

- Structure of a technical report
- Factual content of the report
- Example of submitted texts
  (how the message should not look like)
- Use of AI tools
- Plagiarism and copying



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Národní plán obnovy

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

Why do we learn to write technical reports?

- Technical reports, manuals, standards, and directives
  are the typical output of an engineer's work.
- Reports are used to document results, communicate with others, and manage people.
- According to these outputs, technical workers are usually evaluated.
- Bachelor's and Diploma theses usually have a form of technical reports.
- Beware of mistakes (spelling, simple formulas).
  Incompetent subordinates will especially take advantage of such mistakes.

Formal content of the report

Factual content of the report

Formal Content of the Report

1. Title page (title, author, date, ...).
2. Introduction (brief description of the solved problem).
3. Problem analysis, solution proposal, expected functionality
   (specification, task formulation, related work).
   If it follows from the analysis, it is possible to indicate changes to the specification.
4. Problems solution, mathematical description, algorithms.
5. Implementation (do not go into details).
6. Description of experiments and experimental results.
7. Critical discussion of results (conclusions).
8. Conclusion (brief summary of results).
9. References (citation of used sources).
10. Attachments (if necessary).

Note:

The report may not contain all the chapters listed (items).
It is the author's discretion what is relevant for a particular text.

General Requirements for a Technical Text

- The text does not contain factual or grammatical errors.
- Each document must have the name of the author or authors and the date of preparation.
- Elements in the text (pages, equations, figures, tables) are numbered so that they can be easily referenced.
- Each figure and table has a legend that describes its content.
- Equations and mathematical symbols are written in the form used in mathematics books, not in pseudocode form.
- The wording used should be clear and unambiguous.
- We always use one name for one thing, which we explain the first time we use it.
- **Graphs:** described axes, indicated units, and legend to the waveforms.
- **Tables:** clear and unambiguous texts; don't forget the units.
- Numbers (mainly in tables) have appropriate precision depending on their origin.
- The text must be connected (formally and factually) even if several authors write it.

Factual content of the message

Questions we should ask:

- Who is the message intended for?
- What would we like to tell the reader by the report?

Different views on the content of the message

1. The text and data in the report must enable full implementation of the proposed methods and algorithms. According to the technical report, a person with the same education as the author (for example, a classmate) should be able to implement the algorithm again with the same behavior and results.
2. The description and presented values must be sufficient to assess the correctness and functionality of proposed methods and algorithms by another technician with similar education.
3. The report's content should convince the reader of the functionality of the implemented solution (carefully described experiments, results, graphs).
   It must also allow experiments to be repeated.

What to Write in the Report – Introduction/ Conclusion

Introduction

- Introduce the reader to the issue more generally.
- State the motivation and goals of the work (brief assignment).
- Define basic assumptions and limitations.
- You can indicate the method of solution (especially if it is chosen).

Conclusion

- Briefly summarize the work done (content of the report).
- Present the most important results and conclusions (information that the author would like to tell).
- You can briefly describe options for continuing work.

Abstract

- is a brief summary of the introduction and conclusion;
- may not always be present.

Note:

After reading the introduction and conclusion, the reader should be familiar with the issue and all of the significant results and conclusions that we want to communicate to him. The rest of the text develops, specifies and substantiates the claims made in these sections.

What to Write in the Report – Main Part

Analysis of the problem – describes the solution, and to dividing it into sub-tasks.

- Description of individual subtasks and their interfaces.
- Expected functionality and conditions (specification).
- An analysis of the related works of others (literature) is also included.

Solving the problem – represents the math description and algorithms used.

- Mathematical description of individual steps and their solutions (calculations).
- Description of algorithms and procedures (text, pseudocode, references).
- Details necessary for implementation (inc. specific values) must be provided.
- Clarification or modification of the specification can be included.

Implementation – describes how algorithms are implemented.

- Hardware and programming language used.
- Implementation details (e.g. data representation, program breakdown, optimization/simplification of calculation, new algorithms).

What to Write in the Report – Images

A picture is easier to understand than a long explanation.

- Block chart, Flow chart, State chart, Technical drawing, ...

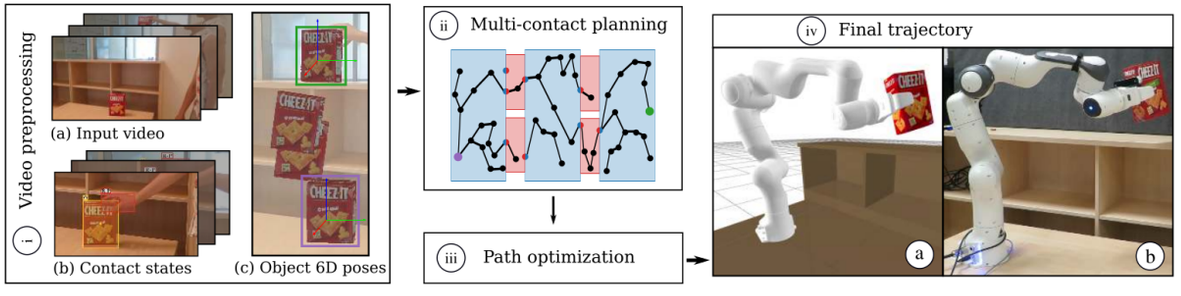

Fig. 2. **Approach overview.** (i) First, we extract contact states and 6D object poses from the input instructional video as described in Sec. III-A. (ii) Next, we grow multiple trees in the admissible configuration space until we find a path between the start and goal configurations. More details on the state space are in Sec. III-B and more details on planning the path in Sec. III-C. (iii) This path is then further shortened by an optimization module, and (iv) executed either in simulation (iv-a) or on a real-world robot (iv-b).

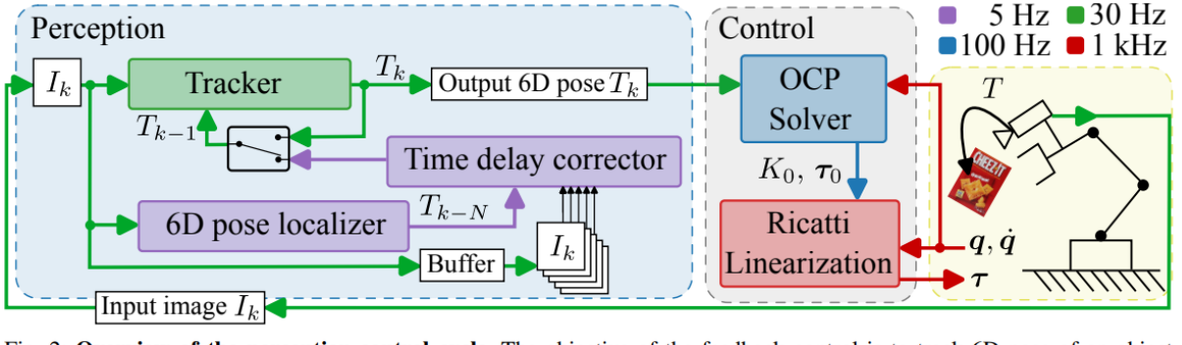

Fig. 2: **Overview of the perception-control cycle.** The objective of the feedback control is to track 6D pose of an object seen by a camera, as illustrated on the right by a robot and red cheez-it box. To achieve that, we designed a perception module that runs a fast local Tracker on an input image I_k with the initial pose T_{k-1} selected either from the previous run of the tracker or from the 6D pose localizer & Time delay corrector modules, if that information is available. The 6D pose localizer is slow and the objective of the Time delay corrector is to *catch-up* in time by quickly tracking through images stored in the buffer while the 6D pose localizer was computing. The output of the tracker, the pose T_k, is used by the OCP solver to compute Ricatti gains K_0 and torques τ_0 that are used by the Ricatti Linearization module to provide fast feedback for real-time robot control. Typical processing frequencies of individual modules are 5 Hz for the 6D pose localizer and the time delay corrector, 30 Hz for the camera and tracker, 100 Hz for the OCP solver, and 1 kHz for real-time robot control.

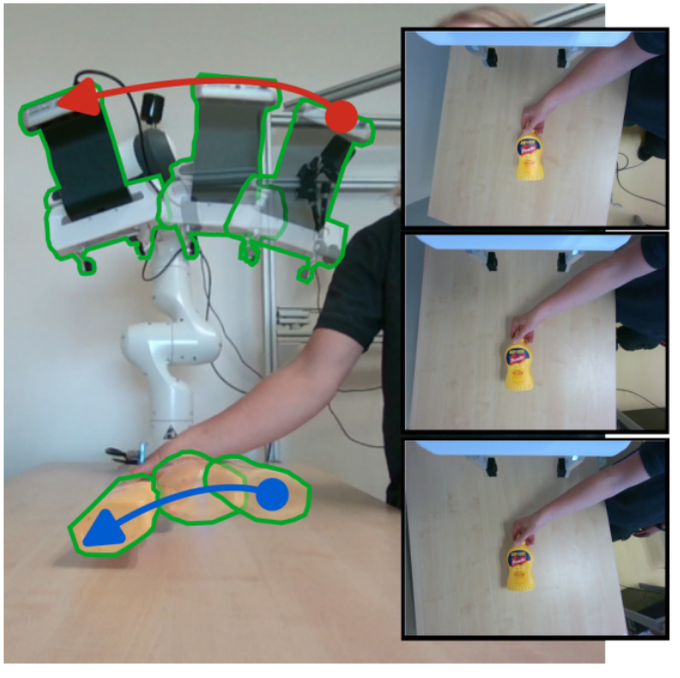

Fig. 1: **Robot arm control by 6D pose of the object.** The objective is to control the robot arm with a mounted camera (red arrow) by commanding joint torques such that the object 6D pose (blue arrow) w.r.t. the camera remains constant. This is illustrated by three frames (see insets) captured by the robot camera corresponding to the robot/object poses shown by green contours in the main image. Please note (see the insets) how the object pose remains stable while the background changes in the captured frames. **More results and experimental analysis in the companion video.**

Images: Kateryna Zorina, Vladimír Petrík, CIIRC ČVUT

What to Write in the Report – Results

Experiments and results

- Definition of the aim of the experiments and their design.
- Method of implementation and specification of evaluation (what we measure).
- The results themselves (graphs, tables).

Discussion of results and conclusions – the results of experiments lead to conclusions.

References – citation of used sources.

Appendices

- They are used to increase the clarity of the text (reduction of the scope).
- This includes information we want to communicate (keep) but that is not necessary for conveying the main message.
- Long math proofs and implementation details (code listings) are often here.
- Supplementary results (data), extended experiments are located here.
  The main text presents the necessary parts of the results and conclusions, referencing the extended results in the appendices.

Examples of the Report – Assignment

Kinematická kalibrace manipulátoru.

Realize kinematic calibration of the parallel planar manipulator.

1. Build a system of equations of binding conditions.
2. Design the calibration positions of the manipulator.
3. Save the proposed calibration positions defined by joint coordinates to a file data.mat in MAT format, which will be part of the submitted archive.
4. Implement the iterative algorithm for kinematic calibration in MATLAB.
5. During the calibration, do not forget to check the conditionality.
6. Use the DKT solution to prepare data for testing and verify the functionality p
7. Document the functionality of the calibration in the report. For example, the manipulator's estimation error, which depends on the accuracy of the reference measurement, is an interesting parameter.
8. If the Jacobi matrix of the criterion function is needed for your solution, enter it into the report (if not automatically generated, in e.g. Maple). If you use a standard optimization function, list the parameters you have set.
9. Check the syntax of your code with the mlint command. Your code should not generate any errors or warning messages.
10. Prepare drawings, diagrams, math derivations, and the report in PDF format. Upload the report as the result of a task marked with the same sequence number as the one assigned task with the suffix "report".

Examples of the Report – Texts

PDF files

are presented separately (not included)

Examples of the Report – What's Missing

Example 1:

- The name of the author and the date are missing.
- The report's name should be readable and correspond to the content (HW 5 is not).
- Neither the binding equations nor the calculation of J are given.
- The choice of calibration points is not described. No points or justifications are given.
- I lack verification of the functionality of the calibration (see assignment).

Example 2:

- Equations in the report should be presented using math notation.
- The equation for calculating "new offset" does not make sense due to its notation (probably wrong).
- The parameters of the equation for calculating the "new offset" are not explained.
- The graph in Figure (a) has the axes and colors without description.
- This chart is pointless because nothing can be read from it.
- The selection of calibration points is not described.
- The error is not defined, nor is the minimization method described.
- I lack verification of the functionality of the calibration (see assignment). For example, a graph of the dependence of the parameters estimation on the measurement error.

AI Tools Usage

Basic thesis

- AI tools can help significantly
  (programming, spell check, reformulation, literature search, topic familiarization).
- The use of AI tools must always be under ethical principles.
- There is a real risk of using foreign text/results without citation.
- The author is responsible for the content of the work (including errors delivered by AI).

Cybernetics risks

- AI does not have to maintain the confidentiality of information or protect personal data.
- The uploaded texts and data are usually used for further learning.
- The data provided to the AI is readable/property of the AI provider.
- The problem is sharing sensitive data, personal data, and own results.

What should definitely not be the work of AI?

- Essential ideas and principle points, same as results
  (need to understand the topic; results supported by own work)
- Citations (AI tends to make things up; meticulous checking is required)

Note: *The AI tools in this case are apps like ChatGPT, Microsoft Bing, Google Bard, Github Copilot, Midjourney, Stable Diffusion, Jasper and others?*

Copying and Plagiarism

Two cases:

1. Defense of the bachelor's thesis

- A wrong formula (Bayes) in the thesis.
- A formula well copied from the literature (author's error).
- Literature was not cited.

2. One of the tasks within a course

- The student repeats the course.
- He submitted the correct solution for the task last year.
- This year, he uploaded a classmate's solution to the submission system (plagiarism).
- Explanation: They share a room and a computer in the dorm. He uploaded his friend's solution from last year by mistake (wrong directory).

Images: https://www.openclipart.org

Sources and References

[Achtenova-AI2024] Gabriela Achtenová. **Rámcová pravidla používání umělé inteligence na ČVUT pro studijní a pedagogické účely v Bc a NM studiu**. Metodický pokyn ČVUT v Praze, CVUT00001676/2024, January 2024.
https://www.cvut.cz/legislativa-tykajici-se-studia#umela-inteligence

[Achtenova-etic2024] Gabriela Achtenová. **Metodický pokyn O dodržování etických principů při přípravě vysokoškolských závěrečných prací**. Metodický pokyn ČVUT v Praze, CVUT00001673/2024, January 2024.
https://www.cvut.cz/legislativa-tykajici-se-studia#eticke-principy

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