

Assessment of Masters' Thesis as a Supervisor

Title: **Part localization for robotic manipulation**
Author: **César Augusto Sinchiguano Chiriboga**
Supervisor: **Dr. Gaël Écorchard**

Fulfillment of Assigned Tasks

All assigned tasks have been fulfilled and the student implemented a demonstrator for his algorithm. The ground-truth system was primitive but fulfilled the needs of reference for the student. César proved that he can independently search for appropriate literature and make a good use of the knowledge gained by his reading. Some big difficulties were encountered regarding the data quality from one the used camera, which eventually appeared to be unsuitable for the given task, but César was able to adapt to a new camera in a short time near the end of his thesis. During the whole period where César worked under my supervision, he proved that he can work independently. Consultations were constructive but César was sometimes slow to provide some of the results I wanted or implement some of my suggestions.

Resolution Methods

The used methods are mostly known and their use was adequate. The most interesting part of César's work consisted in putting all the different methods together into a complete pipeline both the the calibration of the camera and the 3D registration system. The part that could have benefited from some automation is the preparation of the reference data, both from CAD data and from the camera, which still requires lot of manual work and the use of several softwares or libraries.

In the part dealing with the hand-eye calibration, the SolvePnP is applied for each image but the details how the results from the different images are combined are missing.

In the part dealing with the description of the pipeline for 3D point-cloud registration, it is unclear whether the filtering is applied before or after downsampling as both variants are stated. Also there, the pass-through filter step is not clearly explained and would have required some equations explaining it.

Obtained Results

The results are numerous and well documented. What I am missing though would be some results of the 3D registration over the complete range of poses. Most results concern the results of the 3D registration from the object in upright position with some displacement in x and y directions and some rotation with a limited angle. The use of different templates to ensure the 3D registration from random poses appears near the end of the thesis but too succinctly.

Practical Requirements

The thesis is very well presented and well written. Figures are of good quality but the visual quality of plots could have been improved by using a vector graphics format rather than a bitmap image. Some of the figures are not cited, as e.g. 5.3 and 5.5. The caption

for Figure 5.6 is incorrect as it is a copy of the one for Figure 5.3. Table 6.6 is also a copy of Table 6.5, so that non-substantial results are missing. At the top of page 52, the text incorrectly refers to Table B.1 instead of Table 6.7.

Bibliographic references are numerous and appropriate. There are, however, some errors and style inconsistencies that should have been avoided in the bibliography. Referred authors are given sometimes with the full name sometimes with abbreviations. The type of citation is unclear for references 3 and 31. Reference 10 has no date.

General Comments and Conclusion

César accomplished a lot of work, considering the fact there was no preliminary individual project on the subject and this work was introductory also for myself. He proved that he can work independently on a research subject. The provided software is functioning, though with some limits, and was used already in a official robotic demonstration. The provided code looks reasonable but some inappropriate variable namings and missing comments make the code a bit difficult to maintain or improve without the student's help or without a deeper knowledge of the whole code. The software development and all experiments were carried out by the student himself. The manuscript is well presented and well structured but some little mistakes could have been avoided with another proof-reading and a greater care should have been given to the presentation of the bibliography references.

As a conclusion, I advise the commission to evaluate the presented Masters' thesis with the grade

B - Very Good.

Prague, June 7, 2019

Dr. Gaël Écorchard
ČVUT, CIIRC

I. IDENTIFIKAČNÍ ÚDAJE

Název práce:	Part localization for robotic manipulation
Jméno autora:	Cesar Augusto Sinchiguano Chiriboga
Typ práce:	diplomová
Fakulta/ústav:	Fakulta elektrotechnická (FEL)
Katedra/ústav:	Department of Control Engineering
Oponent práce:	Karel Zimmermann
Pracoviště oponenta práce:	Department of Cybernetics

II. HODNOCENÍ JEDNOTLIVÝCH KRITÉRIÍ

Zadání <i>Hodnocení náročnosti zadání závěrečné práce.</i> Vložte komentář.	průměrně náročné
--	-------------------------

Splnění zadání <i>Posuďte, zda předložená závěrečná práce splňuje zadání. V komentáři případně uveďte body zadání, které nebyly zcela splněny, nebo zda je práce oproti zadání rozšířena. Nebylo-li zadání zcela splněno, pokuste se posoudit závažnost, dopady a případně i příčiny jednotlivých nedostatků.</i> The assignemnt has been fulfilled.	Zvolte položku.
---	------------------------

Zvolený postup řešení <i>Posuďte, zda student zvolil správný postup nebo metody řešení.</i> Vložte komentář.	správný
---	----------------

Odborná úroveň <i>Posuďte úroveň odbornosti závěrečné práce, využití znalostí získaných studiem a z odborné literatury, využití podkladů a dat získaných z praxe.</i> Vložte komentář.	A - výborně
---	--------------------

Formální a jazyková úroveň, rozsah práce <i>Posuďte správnost používání formálních zápisů obsažených v práci. Posuďte typografickou a jazykovou stránku.</i> (1) Language is OK, but some implications are littlebit myopic. Assumption „If the robot wants to grasp an object, it has to localize object relative to itself“ does not imply that the detection has to be performed explicitly and that an exact 3D CAD model of the object has to be provided in advance. Human are also able to collect object that they have never seen in advance. (2) Bars on pages 36 and 37 could have been replaced by summarizing statistics (image indices has no meaning for the reader).	A - výborně
---	--------------------

Výběr zdrojů, korektnost citací <i>Vyjádřete se k aktivitě studenta při získávání a využívání studijních materiálů k řešení závěrečné práce. Charakterizujte výběr pramenů. Posuďte, zda student využil všechny relevantní zdroje. Ověřte, zda jsou všechny převzaté prvky řádně odlišeny od vlastních výsledků a úvah, zda nedošlo k porušení citační etiky a zda jsou bibliografické citace úplné a v souladu s citačními zvyklostmi a normami.</i> Wider state-of-the-art should have been discussed, for example discussing reactive approached for grasping, such as [1]. [1] Levine et al. Learning Hand-Eye Coordination for Robotic Grasping with Deep Learning and Large-Scale Data Collection 2016. https://arxiv.org/abs/1603.02199	B - velmi dobře
--	------------------------

Další komentáře a hodnocení

Vyjádřete se k úrovni dosažených hlavních výsledků závěrečné práce, např. k úrovni teoretických výsledků, nebo k úrovni a funkčnosti technického nebo programového vytvořeného řešení, publikačním výstupům, experimentální zručnosti apod.

Vložte komentář (nepovinné hodnocení).

III. CELKOVÉ HODNOCENÍ, OTÁZKY K OBHAJOBĚ, NÁVRH KLASIFIKACE

Shrňte aspekty závěrečné práce, které nejvíce ovlivnily Vaše celkové hodnocení. Uveďte případné otázky, které by měl student zodpovědět při obhajobě závěrečné práce před komisí.

Předloženou závěrečnou práci hodnotím klasifikačním stupněm **A - výborně**.

Reasonable engineering pipeline, described in a readable form.

Questions: Discuss possibility of using a reactive approach such as [1] for bin-picking scenario.

Datum: 3.6.2019

Podpis:

