author2hash=61151e3691774bd7a6ecf72e3c15d034family=Foley, familyi=F., given=James D., giveni=J. D.hash=1a43815572691c3036032556ca985ab6family=Van Dam, familyi=V. D., given=Andries, giveni=A. author4hash=e78d2b3fb9e524baeeae523193eff0a2family=Milder, familyi=M., given=Peter A., giveni=P. A.hash=ed0968f33daf36ae7577303e24b5a504family=Ahmad, familyi=A., given=Mohammad, giveni=M.hash=9880b5c3ff04162daf0a04a66e216f68family=Hoe, familyi=H., given=James C., giveni=J. C.hash=8f4f7b9935992aa7a20147800e695b1efamily=Püschel, familyi=P., given=Markus, giveni=M. author12hash=8e572e053b9e2d0e291c58afee0d4ef8family=L familyi=L., given=Mike, giveni=M.hash=de65b2e7b30cd104c19958da74769b24family=Chou, familyi=C., given=Po-Wei, giveni=P.-W.hash=e8cbb9863284d5792a549c55ede4241dfamily=Tian, familyi=T., given=Stephen, giveni=S.hash=cc98893b6272e9f898274231af5ce0fdfamily=Yang, familyi=Y., given=Brian, giveni=B.hash=56716a6072771ab572febbef5742e6effamily=Maloon, familyi=M., given=Benjamin, giveni=B.hash=7f0a7103fd2a42207e8a6e5addee0dd5family=Most, familyi=M., given=Victoria Rose, giveni=V. R.hash=72988a9d5f1036cd38daff02706075bbfamily=Stroud, familyi=S., given=Dave, giveni=D.hash=9926c84a4513ee3ba24e96b14984c2c5family=Santos, familyi=S., given=Raymond, giveni=R.hash=5a4c10a2eab875989c6db344e2e1fc56family=Byagowi, familyi=B., given=Ahmad, giveni=A.hash=6967e111a329dd8ad17e1cfea1f6828ffamily=Kammerer, familyi=K., given=Gregg, giveni=G.hash=cd27d3d228b115c84bc1d88310a81f02family=Jayaraman, familyi=J., given=Dinesh, giveni=D.hash=864584c60b808b517f2a06c664ec116afamily=Calandra, familyi=C., given=Roberto, giveni=R. author6hash=3c28f6c119fb412167f027284c50ea20family=Ivaniu familyi=I., given=Egor, giveni=E.hash=d225efc214dc8ddf8bc673dc7a46058dfamily=Friedrich Eichenauer, familyi=F., given=Martin, giveni=M.hash=6c6ab989abdd7efb0c00e7137cbea13bfamily=Tošić, familyi=T., given=Zlata, giveni=Z.hash=6346898b21792c539e6cbbc762b4e8cefamily=Müller, familyi=M., given=Steffen, giveni=S.hash=25d9404dd618735597e8965c82de45f1family=Lordick, familyi=L., given=Daniel, giveni=D.hash=4d74b5abdb39949261be7c6c4af27ce3family=Mechtcherine, familyi=M., given=Viktor, giveni=V.

TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science

Institute of Software- and Multimedia-Technology
Chair of Software Technology

Master Thesis

Integrating Tactile Sensing and Image Processing in Robotic Automation for Bridge Construction

Wei Ling

Born on: 15th December 1997 in Shanghai
Matriculation number: 4982284

7th June 2024

Referee
Prof. Dr. rer. nat. Uwe Aßmann

Supervisor
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TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Software- and Multimedia-Technology

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Task for the preparation of a Master Thesis

Course:	Distributed Systems Engineering
Name:	Wei Ling
Matriculation number:	4982284
Matriculation year:	2020
Title:	Integrating Tactile Sensing and Image Processing in Robotic Automation for Bridge Construction

Objectives of work

Momentan ist das besagte Thema in aller Munde. Insbesondere wird es gerade in vielen – wenn nicht sogar in allen – Medien diskutiert. Es ist momentan noch nicht abzusehen, ob und wann sich diese Situation ändert. Eine kurzfristige Verlagerung aus dem Fokus der Öffentlichkeit wird nicht erwartet. Als Ziel dieser Arbeit soll identifiziert werden, warum das Thema gerade so omnipräsent ist und wie dieser Effekt abgeschwächt werden könnte. Zusätzlich sind Methoden zu entwickeln, mit denen sich ein ähnlicher Vorgang zukünftig vermeiden lässt.

Focus of work

- Recherche & Analyse
- Entwicklung eines Konzeptes & Anwendung der entwickelten Methodik
- Dokumentation und grafische Aufbereitung der Ergebnisse

Referee:	Prof. Dr. rer. nat. Uwe Aßmann
Supervisor:	Wanqi Zhao
Issued on:	
Due date for submission:	

Prof. Dr. rer. nat. Uwe Aßmann
Supervising professor

Statement of authorship

I hereby certify that I have authored this document entitled *Integrating Tactile Sensing and Image Processing in Robotic Automation for Bridge Construction* independently and without undue assistance from third parties. No other than the resources and references indicated in this document have been used. I have marked both literal and accordingly adopted quotations as such. There were no additional persons involved in the intellectual preparation of the present document. I am aware that violations of this declaration may lead to subsequent withdrawal of the academic degree.

Dresden, 7th June 2024

Wei Ling

TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Software- and Multimedia-Technology

Chair of Software Technology

Abstract

This is an abstract. The abstract is written after finishing the work and should give an overview about the motivation, used methods, as well as the results. It is here to inform the reader about the core topics of the work and if it is relevant to his research. The abstract stands for itself and uses no components of the rest of the work. In consequence, there are no references nor citations used here. It should be around 100 to 250 words. There should always be an english version of your abstract, regardless of the language the work is actually written in.

Contents

Symbols and Acronyms

CeTI	Centre for Tactile Internet with Human-in-the-Loop
GPU	Graphics Processing Unit
ROS	Robot Operating System

0 About Latex and this Template

This is the official template for the chair of computer graphics and visualization. It is based on the TU corporate design, more exactly on the `tudscrbook` class, which is a wrapper for the `scrbook` Koma script. The documentation[1] of the wrapper class might be useful, if there are things you need to understand and are not covered in this short description.

0.1 Using the Template

This template comes with a few files. This section will guide you through their structure, but will also explain, how to switch languages and how to change the type of your work.

0.1.1 File Structure

The multiple files of this template contain the different parts of the work. They are all brought together by the `main.tex` file, which solely purpose is, to connect all the files as the *root document*. When you are using Texmaker or TeXStudio to edit and compile these files, you should apply the option to make this file the *root document*.

All other text files are contained within four folders:

- **0_frontmatter:** Contains all files that are technically needed to define the documents properties and formal pages such as the *"Statement of Authorship* as well, as all other parts of the work, which are placed before the actual chapters of the work.
- **1_mainmatter:** Contains the chapters of the work
- **2_bib:** Contains the bib-file, as well as a tex file to print the bibliography within the document. It is possible to use multiple bib-files, just make sure every file is added in the *header* with `\addbibresource{path to file}`.
- **3_appendix:** Contains any appendix files, in the template, there is only an example file with some blind text.

There are two additional folders:

[1] https://ftp.tu-chemnitz.de/pub/tex/macros/latex/contrib/tudscr/doc/tudscr.pdf

- **fig:** For image files.
- **logo:** Containing the logos of the chair.

Within the frontmatter-directory, there are the following files:

- **0_header:** Containing the definition of the used class, as well as most parameters and used packages.
- **1_title:** Defines the information used for creating the title. It is also used to define some pdf meta data. The subject of the work is also defined in this file. All possible subjects can be found in the documentation.
- **2_task:** A file used to include the task description.
- **3_declaration:** Adds the statement of authorship.
- **4_abstract:** Side containing an English and a German abstract.
- **5_acronyms:** The place to declare your used acronyms.

0.1.2 Changing the Language to German

The standard language for this template is English. However, everything needed for changing the language to German is already in the template. To do this, enter the `0_frontmatter/0_header.tex` file and search the first few lines of the document for `ngerman, english,` in the `documentclass` options. Then swap the order to `english, ngerman,`. You still have to translate some of the text, but most things should change into German automatically.

0.1.3 Biblatex and Biber

This template uses `biblatex` and `biber` for creating a bibliography. However, most editors use the older `bibtex` as a standard[2]. To change this in TeXStudio or Texmaker, just enter Options -> Configure TeXStudio/Texmaker -> Build and change the default bibliography tool from bibtex to Biber. You can also just change the bibliography back to bibtex in the *0_frontmatter/0_header.tex* file by replacing the `backend=biber` option for the `biblatex` package back to `bibtex`. Most scientific resources allow to export a bibtex-citation directly, which can be copied to the bib file and used with the `\cite{<identifier>}` command. The result should look like this: [Foley1982].

0.1.4 Adapt the Template to Different Types of Works

When writing a diploma, bachelor's or master's thesis, there is little to change in this template. The `\subject`-field in the title page, see Table 1 for possible values, and the `\graduation[<short form>]<degree>`-field in the `0_frontmatter/1_title.tex` need to be adjusted. For other works, the task-description and declaration of independence should be removed by deleting the lines referencing the files `2_task.tex` and `3_declaration.tex` in the `main.tex` file, the list of figures and the list of tables could also be removed there. When the work is never intended to be printed, it might also be a consideration to change some of

[2] A discussion of the differences of both bibliography tools and the problems one or the other may cause can be found here: https://tex.stackexchange.com/questions/25701/

Table 1: All possible types of work.

Value	German	English
diss	Dissertation	Dissertation
doctoral	Dissertation	Dissertation
phd	Dissertation	Dissertation
diploma	Diplomarbeit	Diploma Thesis
master	Master-Arbeit	Master Thesis
bachelor	Bachelor-Arbeit	Bachelor Thesis
student	Studienarbeit	Student Thesis
evidence	Großer Beleg	Student Research Project
project	Projektarbeit	Project Paper
seminar	Seminararbeit	Seminar Paper
term	Hausarbeit	Term Paper
research	Forschungsbericht	Research Report
log	Protokoll	Log
report	Bericht	Report
internship	Praktikumsbericht	Internship Report

the options for the `\documentclass` in the `0_frontmatter/0_header.tex`. Expecially there is no need for additional space at the inside, so the `bcor`-parameter, used to compensate the print area in respect to the book thickness when printed, can be set to zero or removed completely and the `twoside`-parameter with the following outside paging might be irritating and can be changed to `oneside`.

0.2 Latex Basics

The following sections will explain some of the Latex basics. It is especially concerned with figures (0.2.2), acronyms (0.2.3), equations (0.2.4), tables (0.2.5) and code listings (0.2.6). If you already worked with Latex, there is probably no need to read this, but if you never used Latex or are stumbling over some of the elements in this template, it might be useful. It shows also some of the notations used at the CGV lab! (CGV lab!), so looking in the source code of this file (`1_mainmatter/0_about_this_template.tex`) might be useful.

0.2.1 Weblinks

For Weblinks there are two ways to include them into a latex document. You can just use the `\url{<url>}` command or use `\href{<url>}{<text>}`. While an example link with the `url` command would look like https://wwwpub.zih.tu-dresden.de/~gumhold/cgv/html/overview.html, href is probably a more elegant solution, where the link to the cgv framework on pub.zih.tu-dresden.de can be embedded into the text. However, as long as the link color is

black (which it should be for printed formats), the link is hard to find and in a printed format, the information about the link is lost entirely, if it is not contained within the text. So writing down at least a part of the link can help with recognizing the link as a link. Links should not be placed in the text, but rather in footnotes using the `\footnote{footnote}`-command.

0.2.2 Figures

You can embed figures with the commands shown in figure 1. The result for an example should look like figure 2. Figure objects are useful to include graphics, but can also host a range of other elements. The most important property of figures is, that they are floating objects, which latex is trying to place where they fit best.

```
\begin{figure}[ht]              % [h] tries to keep the figure [h]ere, [t]op is used as alternative
        \centering              % center the graphic, if it is smaller then the page
        \includegraphics[width=<scaling factor>\textwidth]{<path to the graphic>}
        \caption{<The text to describe the graphic.>}
        \label{<A label to refer to the graphic in the text.>}
\end{figure}
```

Figure 1: Code for embedding graphics

Figure 2: Quadric error metric simplification applied to the Stanford bunny

0.2.3 Symbols and Acronyms

This template uses the *acronyms*-package to include a list of symbols and acronyms at the beginning of the work. Acronyms can be referenced with the `\ac{<identifier>}` command. E.g. using `\ac{GPU}` in this document results in: Graphics Processing Unit (GPU), the name of the acronym or symbol, as well as the acronym or symbol itself in brackets. After the first use, only the acronym or symbol will be used. The `acronyms`-package will throw a warning if an acronym is not used within the work.

0.2.4 Equations

Equations can be used with the math environment, which can be delimited either inline by using the `$ eq $`, `\[ eq \]`, or separated from the text with `\begin{equation} eq`

`\end{equation}`. The latter will additionally enumerate the equation and allows for a label, so we can reference an equation like the equation 0.1.

$$x^n + y^n = z^n \tag{0.1}$$

You can also place equations within a figure. The equation then becomes a floating object and might be placed somewhere else, but can also be captioned, as equation 0.2 in figure 3. However, having an equation start with *"Figure"* is not always optimal. The German "Abbildung" is even worse.

$$x^2 + y^2 = z^2 \tag{0.2}$$

Figure 3: Pythagorean Theorem

CGV specific notation and symbols

In CG we work with 2D, 3D and 4D vectors $v \in \mathbb{R}^d$. Vectors can represent different entities. At the **CGV lab!**, we use the notation shown in figure 4 for them. All the notations can also be looked up in the slides of the cg-courses.

0.2.5 Tables

In Latex, tables are generated using the tabular environment. As this is often far more complicated then in editors following the ***WYSIWYG! (WYSIWYG!)*** principle, a tool for building tables in a **WYSIWYG!** manner and translating them to Latex-Code can be useful. Examples for such tools are latex-tables.com[3] and tablesgenerator.com[4]. When creating tables, there should generally be no vertical lines and only three horizontal lines[5][6]. A table in latex might look like table 2. The code for creating this table can be found in the code box 5. Please note: In contrast to figures, tables must have the caption above the content and also and also should be placed at the top of a page, which is achievable by using the placement parameter `[t]`. For very long tables, the `longtable`-package[7] might help with its support for tables spanning multiple pages.

0.2.6 Code

With the `lstlisting` environment you can show code. The most important difference to normal text is, that spaces and tabs are kept in place within that environment and

[3] https://www.latex-tables.com/
[4] https://www.tablesgenerator.com/
[5] A neat little guide on how to make tables look nice can be found here: https://people.inf.ethz.ch/markusp/teaching/guides/guide-tables.pdf
[6] Another helpful source about tables might be this blog post by Nick Higham: https://nhigham.com/2019/11/19/better-latex-tables-with-booktabs/
[7] For reading even more about tables and the possible packages, this wikibooks entry could be interesting: https://en.wikibooks.org/wiki/LaTeX/Tables

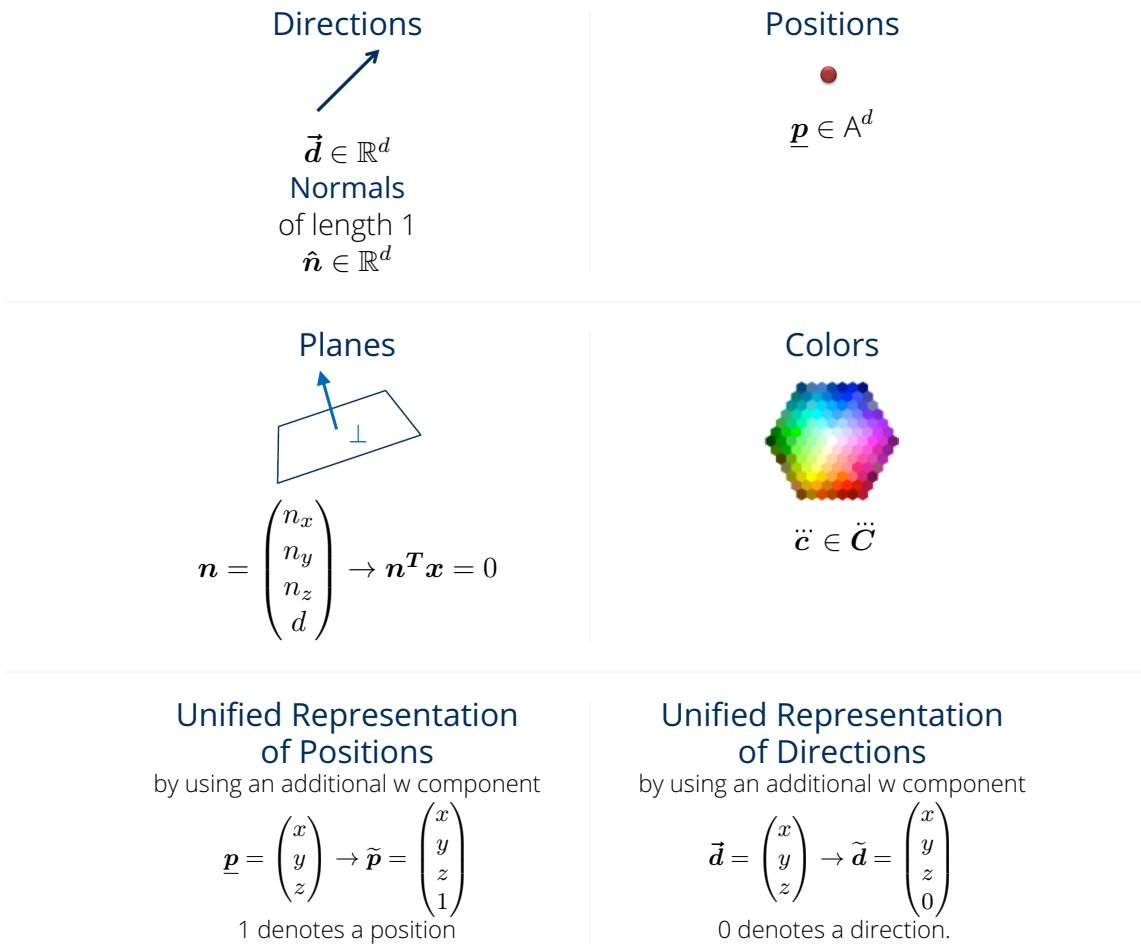


Figure 4: Some of the different notations for multiple types of vectors. All the notation types can be looked up in the computer graphics lecture slides.

Table 2: Average absolute error in slices and percentage, by size of implementation. This table is from a paper from Milder et al. [**Milder2006**].

slices	abs. Error (%)		abs. Error (slices)	
	avg.	max.	avg.	max.
<5000	7.4	75.0	118	835
5000-10000	2.4	14.4	162	756
10000-15000	2.0	11.5	232	1235
>15000	2.3	14.5	438	2287

Latex commands will not be executed. You can however escape latex commands with the [escapeinside=][8] option. An example for how to show code can be seen in 6, which results in 7.

[8] Here is an example on how to do that: https://tex.stackexchange.com/questions/63729/

```
\begin{table}[t]
        \centering
        \caption{Average absolute error in slices and percentage, by size of implementation. This
             table is from a paper from Milder et al. \cite{Milder2006}.}
        \renewcommand{\arraystretch}{1.3}
        \begin{tabular}{@{}rrrcrrc@{}}\toprule
                \multicolumn{1}{l}{slices} & \multicolumn{2}{c}{abs. Error (\%)} & \phantom{abc}&
                \multicolumn{2}{c}{abs. Error (slices)}\\
                \cmidrule{2-3} \cmidrule{5-6}
                                & avg.  & max.  && avg. & max   \\ \midrule
                <5000           & 7.4   & 75.0  && 118  & 835   \\
                5000-10000      & 2.4   & 14.4  && 162  & 756   \\
                10000-15000 & 2.0       & 11.5  && 232  & 1235  \\
                >15000          & 2.3   & 14.5  && 438  & 2287  \\
                \bottomrule
        \end{tabular}
        \label{tab:example}
\end{table}
```

Figure 5: Code for the example table 2

```
\begin{figure}[htbp]
        \begin{lstlisting}
//comment
for(int i = 0; i < 100;i++)
{
        test(i);
}
        \end{lstlisting}
        \caption{Example for a code block.}
        \label{code:example}
\end{figure}
```

Figure 6: Code for showing the code block below. As tabs are preserved in listings, there should be no tabs in the code, that you do not want to see in the output.

```
//comment
for(int i = 0; i < 100;i++)
{
        test(i);
}
```

Figure 7: Example for a code block.

1 Introduction

The chapter should broadly contextualize your research and motivate your work.

1.1 Motivation

In today's increasingly intelligence-focused world, many devices we once regarded as mechanical, fixed, and lacking adaptability are now seeking new changes. Robotics, having been adapted in industries for decades are predominantly used under fixed and pre-defined environment. All the moves are implanted before the actual operation so it has few capabilities reacting to the change of environment. It was partly because of the fact that there are very few sensors applicable for sensing the enviornment. However, with the increasing availability of various sensors on the market, different solutions have made it possible to develop intelligent systems with interactive capabilities, environmental awareness, and adaptive abilities.

DIGIT [Mike2020] designed as textile sensor can be used for robotics that requires high-resouluted texture information. With the help of it, robot arm can detect small deformation of textile surface of contact object which can help increase the precision of robot motion planning. Handling small components, especially in the sense of laboratory environment, needs extra accuracy compared to industrie robots. The modular componentes robot arm dealing with in laboratory does not have a regular shape which means the grasp of robot grippers is not always stable, components might slide away while grasping. Also it happens at the moment of attachment and detachment. They all together raise challenge for intefrating DIGIT sensor in the current system.

1.2 Goal

This section should clarify, what should be achieved by the work.

1.3 Structure of the Work

Here the structure can be *briefly* explained.

2 Background

3 Related Work

Describing the research field with relevant works on the same or similar issues.

4 Methods and Implementation

5 Results

6 Conclusion and Further Work

7 Record of Work

This is a work record created before the actual thesis, which serves to scrutinize and list all possible contents that can be covered by the actual thesis. It contains work of the author that was conducted recently . As the professor's request, these work have to be properly recorded and preserved.

7.1 Digit Sensor

Shall be moved to introduction part

As Professor Aßmann suggested, the possibility of using `DIGIT` sensor [Mike2020] to sense the attitude of pick components is the first matter that has to be figured out. Since the sensor was never experimented in the lab of Software Technology group until Professor Roberto Calandra become a faculty member at TU Dresden. We first have to conduct basic experiments to find out what it actually can do. To be specific, what features of various fabrics this sensor can capture and how we can interpret these captured features. Thus, we need to transform the raw data into fathomable variables that can be integrated into `ROS` systems. Eventually, combining the sensor with our robots that can serve to pick actual bricks for constructions.

7.1.1 Test with Digit Sensor

According to the definition given by [Mike2020], `DIGIT` is a "vision-based tactile sensor". It captures light reflection on elastic gel due to the deformation of elastomers that has physical contact with the object that we want to sense. It is supposedly good at identifying tactile because it doesn't use camera directly to discern features, but instead utilizing an intermediary material that can reflect tactile features.

Couple experiments have been conducted in the lab of Software Technology group. First, common fabrics such as cotton tee shirt and pine wood bricks are tested.

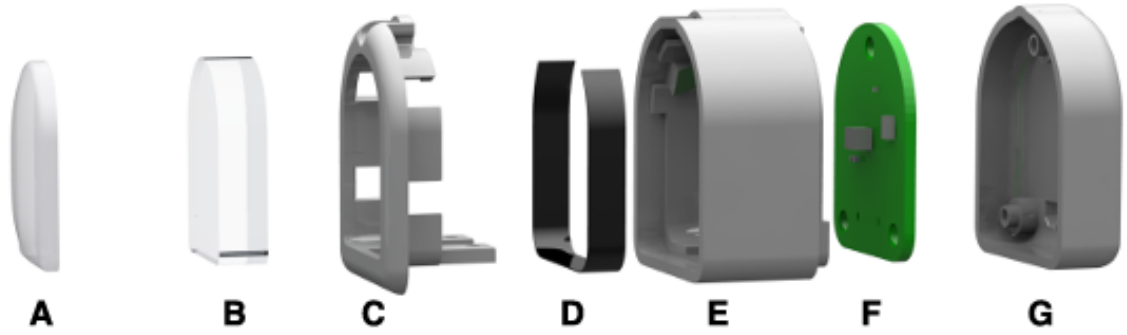


Figure 7.1: Exploded view of a single DIGIT sensor. A) elastomer, B) acrylic window, C) snap-fit holder, D) lighting PCB, E) plastic housing, F) camera PCB, G) back housing.

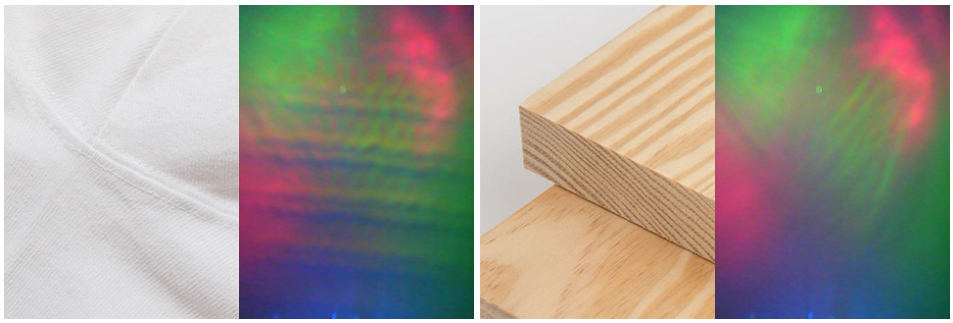


Figure 7.2: Object under test and corresponding raw measurements taken using DIGIT.

As figure 7.2 illustrates, it clearly captures sub-millimeters textures that are normally indiscernible for cameras. Additionally, we tested the sensor performance under different ambient light conditions. DIGIT with LED self-illumination device ensures that the captured images are less affected by changes in ambient light, which means it can output stable features.

7.2 SHCC Frame Modules

Shall be moved to introduction part

Next up, in our common use case, the FRANKA robot utilizes a gripper that has a pair of claws which can pick and drop objects by gripping. We want to test the scenario where grippers of a robotic hand are equipped with DIGIT sensors. In order to test the feasibility of mounting two sensor at the same time, we envisaged a scenario where interference might occur when the objects in contact with two sensors are too thin. This could potentially lead to mutual interference between the elastomers of two sensors, affecting imaging. After testing thin fabrics such as cotton and polyester. It can be confirmed that the interference between the two sensors can be neglected.

Having tested the basic performance of a digit sensor. We decided to further explore its capability by applying it to our current project, bridge frame modules. This is used to construct an arch structure to support subsequent bridge construction. We first assemble blocks that will be utilized for supporting frame modules. This part of construction is already

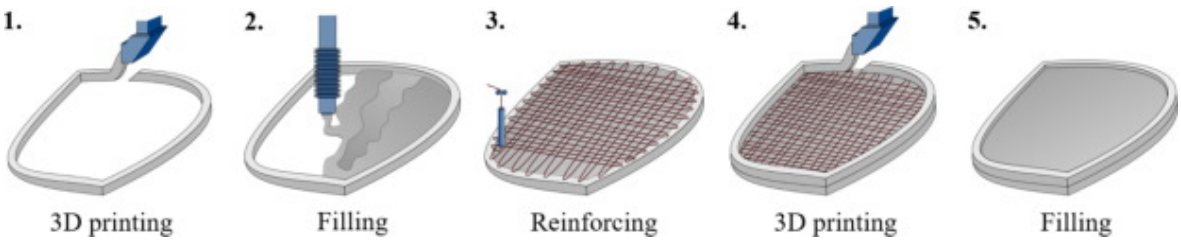


Figure 7.3: Production Steps of Frame modules

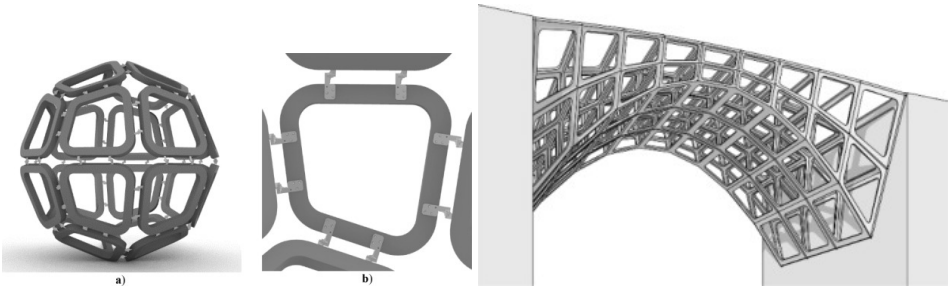


Figure 7.4: Space Frame Bridge built Using PQ-meshes

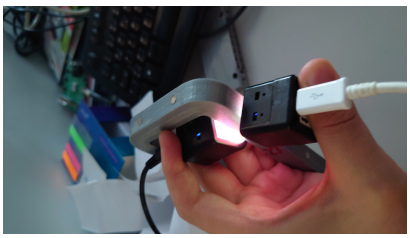
implemented by Wanqi Zhao's algorithms. On top of the brick blocks, we will then build the bridge frame modules which is a simple version of [IVANIUK2022].

In figure 7.3, the production steps of frame module reveal that it has a composite structure. The peripheral part is made of metal and the interior is filled with "printable strain-hardening cement-based composites" [IVANIUK2022]. These modules are normally created to have the shape of planar quadrilateral, because this PQ-meshes can approximate a great variety of freedom surfaces. Using identical PQ meshes, it is not difficult to build different polyhedron, which can contribute to building sophisticated constructions like a bridge as shown in figure 7.4.

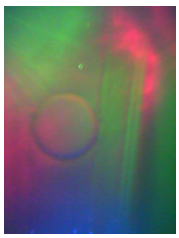
Theory aside, since we are not focusing on civil engineering or material science, the model we use in the laboratory is smaller in size compared to the one mentioned in the paper, and the connection method has been changed from the metal connector to magnetic connector.

7.2.1 Test Design: First Approach

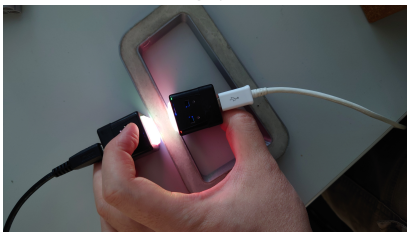
So, I started the experiment using `DIGIT` sensor to have contact with frame modules. These experiments are conceived based on our understanding of the material and performance of the robot arm explained in the former chapter. The irregular quadrilateral appearance of the module makes it difficult for the original Emika gripper to grasp, especially considering the DIGIT sensors that will be added later. Therefore, in order to testify the feasibility of grasping from different angles so that later when it is mounted on the actual gripper, we would have better understanding of the outcome image. So, in the testing phase, we assumed two scenarios to grasp objects from different angle, mainly vertical and perpendicular.



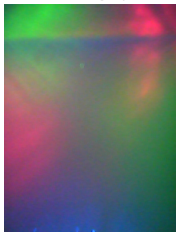
(a) Vertical grip overview



(b) Detail of the vertical grip with DIGIT sensor



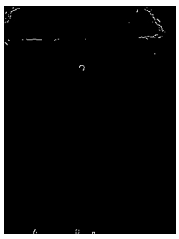
(c) Perpendicular grip overview



(d) Detail of the perpendicular grip with DIGIT sensor

Figure 7.5: Two Gripping Tests

(a) Vertical grip edge detection result



(b) Perpendicular grip edge detection result

Figure 7.6: Two Edge Detection Results

7.3 Image Processing

Since the only output source of a digit sensor is a real-time camera that observes the deformation of elastic gel that reflects LED light projection. Image processing methodologies are very important since they will be the solid base for the upcoming algorithms like edge, angle detection, auto grasp position adjust and eventually textile detection.

7.3.1 Test Design: Pre-process

Naturally, using OpenCV (Open Computer Vision Library) on Python is the most preferable and popular option for image processing. This library consists of around 2000+ optimized algorithms that are useful for computer vision and machine learning.

As we have explained in the introduction part, the digit sensor contains a micro camera: Omnivision OVM7692, a 60 fps color CMOS hosting a microlens array with focal length 1.15 mm and depth of field 30 cm. The size of camera alongside with colo CMOS inevitably leads to the result that output frames' quality will not be very promising. Color noises, color cast, distortions and so on

List of Figures

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A Appendix I

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

B Appendix II

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.