DeMaMech Project Report

Keio University Science and Technology

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2. Excusive summary

I studied in T.U.Berlin from September 2005 to December 2005. My research topic was design methodology of Pahl & Beitz. I studied about this design methodology and redesigned the device which I made last year.

I went to Denmark on January. I studied at Technical University of Denmark, and I took an intensive course for 3 weeks. The title was Laboratory Course in Process Simulation. In this lecture we studied metal casting, thermal contraction of metal product, injection moulding and bulk metal forming with simulation soft for example MAGMASOFT, SIGMASOFT and DEFORM. We could have many good experiences in Europe. There were many students from all over the world.

I described exchange student life in section 5. I mentioned Suggestion and Summary in section 6 and in section 7 respectively.

3. Travel Schedule

Technical University of Berlin: From September to December 2005

Technical University of Denmark: January 2006

4. Technical report

4.1 Technical University of Berlin

Studying of design methodology and redesigning the device

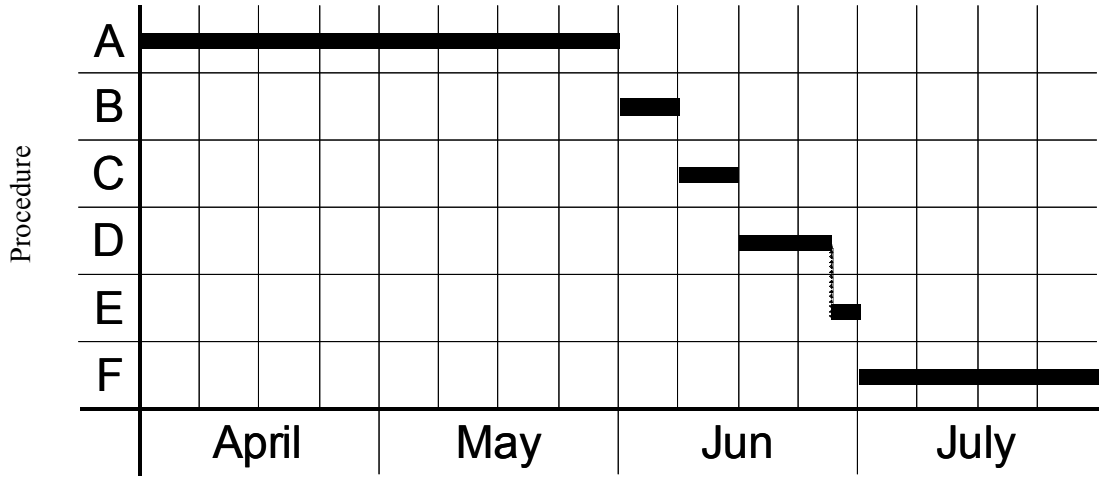
4.1.1 Introduction

Tele-manipulation systems have been studied for use in medicine, space, and other extreme environments. In order to display remote contact condition, various force display have been developed. For dexterous manipulation, however, a force display is not enough because an operator cannot detect a slippage of contact between the remote fingers and the grasped objects. On the other hand, human beings can grip and lift various objects adequately based on afferent signals from tactile receptors even when the weight and the friction coefficient are unknown. From this, a tactile display method that presents condition of friction is important to take full advantage of human dexterous skills. And also, the development of such displays has been demanded. So I design the device which can display tactile sensation last year. But, my way of design was not systematic one. I just designed the device by trial-and-error. My device can work as the tactile display, but there still are some rooms for improvement, for example ICPF actuators need water.

In this study, first, I investigated and describe my design method in last year. Next, I redesign my device with systematic design method of Pahl and Beitz. At last, I compared these two methods each other from some aspects.

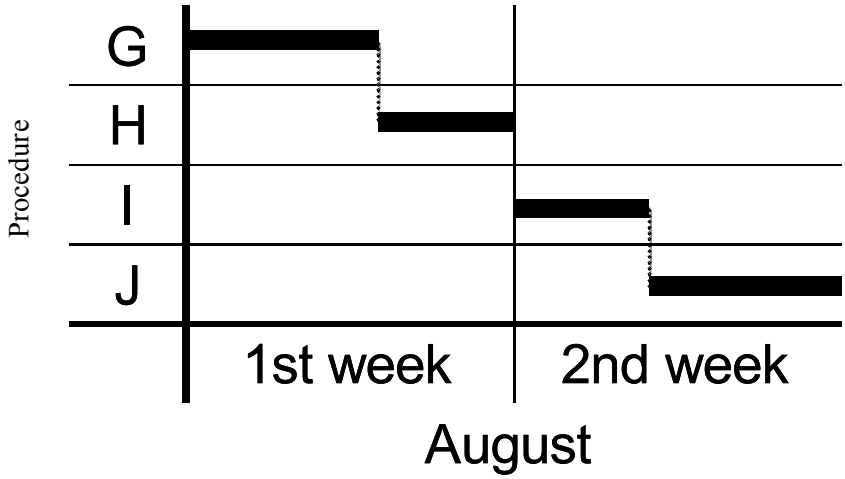
4.1.2 Investigation of the design method used in my research of last year

In this section, it is written about the investigation of the design method which used in my research of last year. Gant-Diagrams based on my work are described for investigation. Four concepts were designed in my research of last year. So, the diagrams are divided into four parts. Each diagram is shown below.



A: Literature study, B: Investigation and evaluation,
C: Decision of actuator,
D: Decision of improving previous device, E: Detail design,
F: Building device

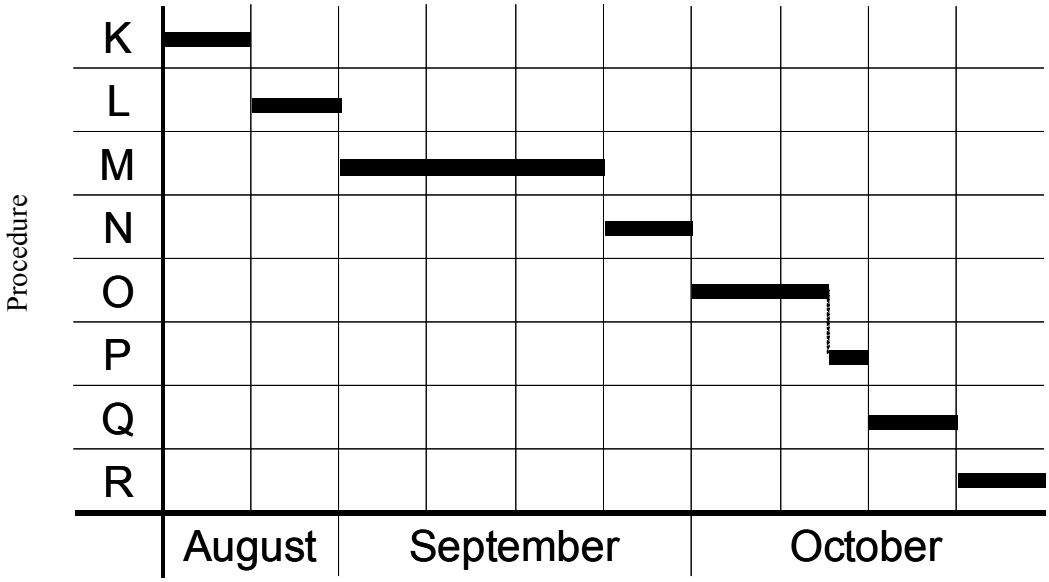
Fig. 4.1 Gant-diagram of the first part



G: Solving problem, H: Decision

I: Detail design, J: Building device

Fig. 4.2 Gant-diagram of the second part



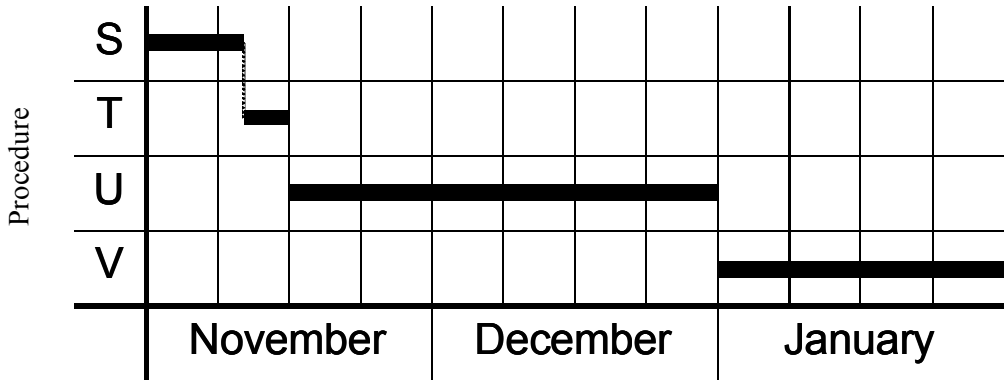
K: Definition of task, L: Detail design,

M: Building device, N: Investigation of device,

O: Solving problem. P: Detail design,

Q: Building device, R: Investigation of device

Fig. 4.3 Gant-diagram of the third part



S: Solving problem, T: Detail design,
U: Building device, V Experiment

Fig. 4.4 Gant-diagram of the fourth part

4.1.3 Redesign of the tactile display with design methodology

In this section, I will talk about the redesign of the tactile display with design methodology of Pahl and Beitz. I redesigned my device by the phase of conceptual design. I did step by step, and I got a conceptual design V_5. The concept variant V_5 generates ultrasonic vibration with PZT. And the vibration is amplified by heat sink. To do so, it will be possible to display partial-slip with vibration. The previous device had a problem that it needed water. But, this new concept does not need water. The rough sketch of this idea is shown in Fig. 4.5. The previous device also have the weak points such as hard to build or hard to maintain, but in the new concept, these weak points are improved. Therefore, I think it is worth while to build this new concept. I will do embodiment design and detail design next, and build this new device.

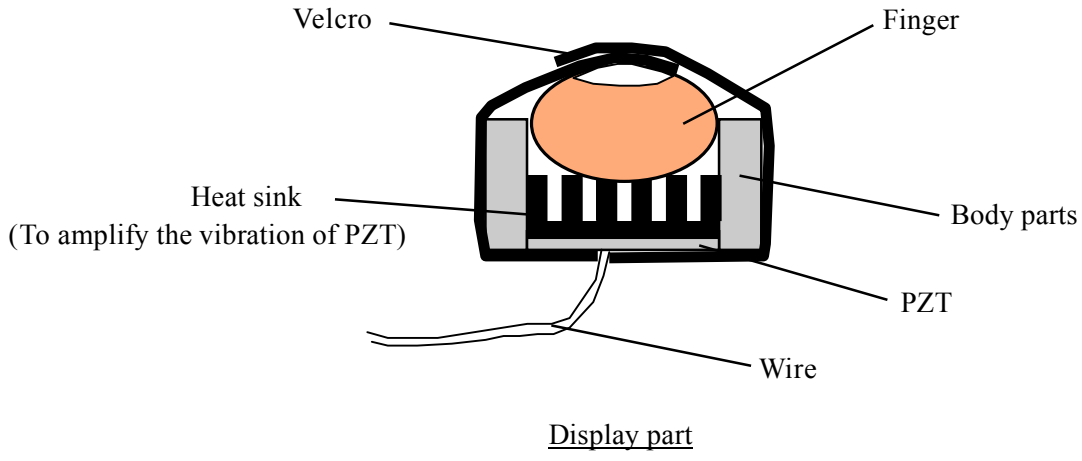
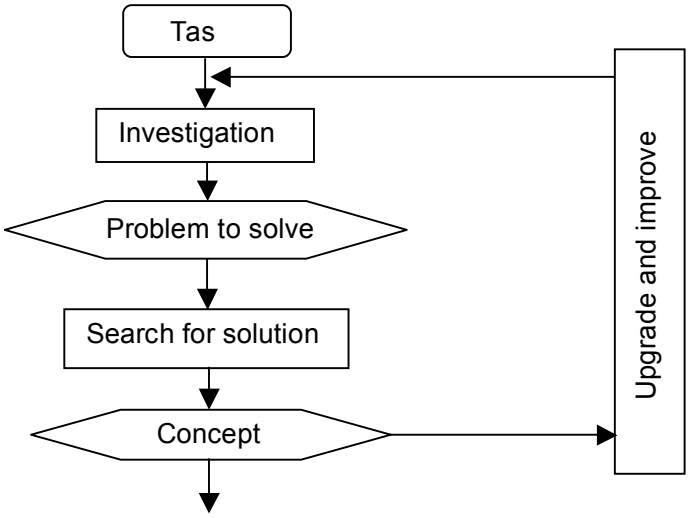


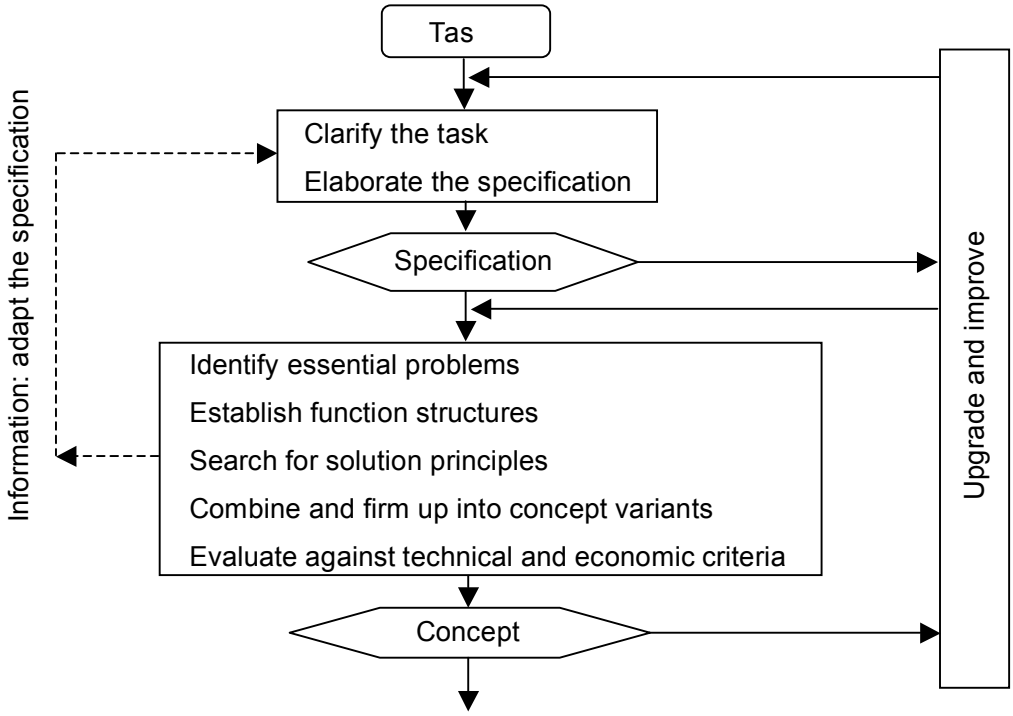
Fig. 4.5 Rough sketch of the concept V_5

4.1.4 Comparison of each design process

I described my design process of last year's study in section 4.1.2, and redesign process with systematic design method of Pahl and Beitz in section 4.1.3. In this section, I will compare with these design processes each other from several aspects. To compare with them each other, I describe the flowchart of each process in Fig. 4.6. In the first process, I did embodiment design and built the device, but did not in redesign process. In Fig. 4.6, detail design process and the process of building of the first process are not described. To do so, I compare with the process of conceptual design each other.



Design process of last year's study (First process)



Design process with systematic design method (second process)

Fig. 4.6 Flowchart of two design processes

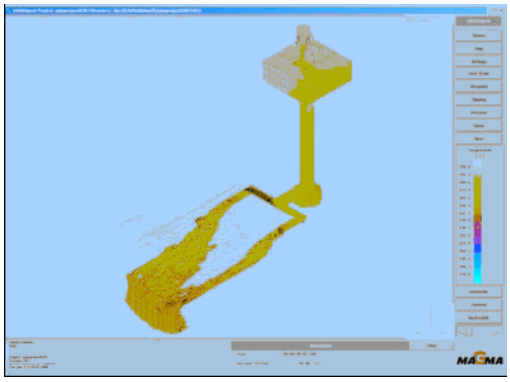
4.1.5 Conclusion

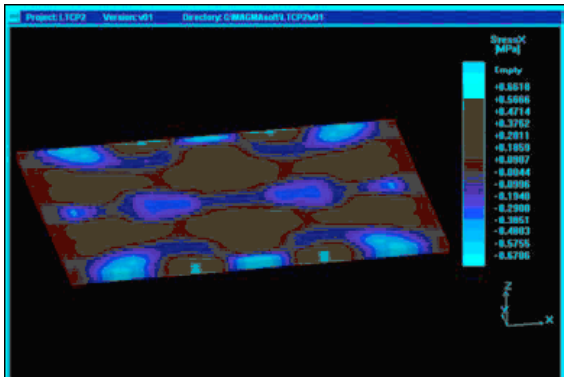
There are some differences between the two design processes. Personally, I prefer the design with design method. One reason is that I can design step by step. Procedures are well-divided, so I can concentrate each procedure and solve each procedure easier. The other reason is that I can search a wide variety of solutions. In the first design process, I only designed the device which used ICPF actuators. But, in the second process, I could find some other methods to display partial-slip.

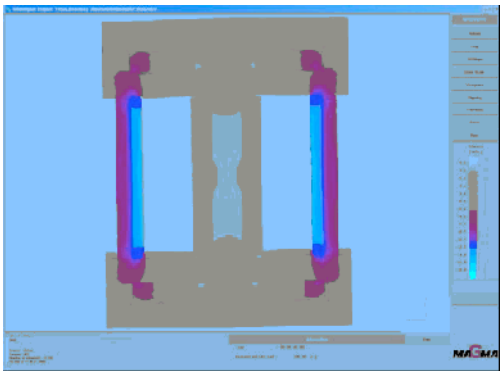
Therefore, I think that the design methodology is good for my design process.

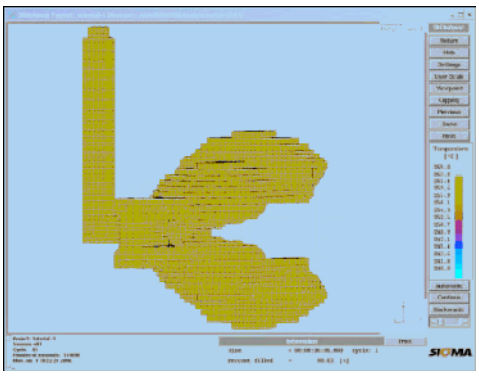
4.2 Technical University of Denmark

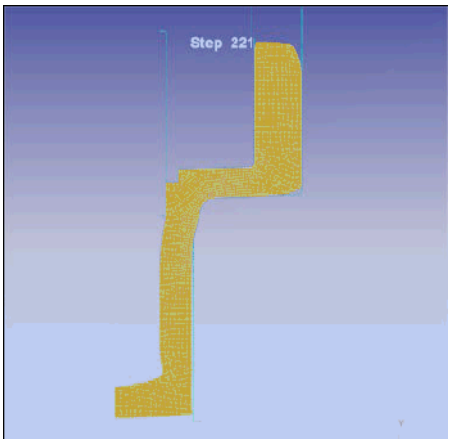
In this lecture we studied metal casting, thermal contraction of metal product, injection moulding and bulk metal forming with simulation soft for example MAGMASOFT, SIGMASOFT and DEFORM. At first we have lecture in this course. After that, I began the exercise. I was engaged in exercise almost time in this course.

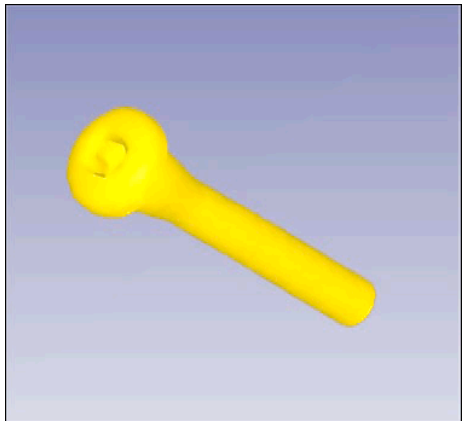












5. Exchange student life

I studied at Technical University of Berlin from September to December. Winter semester started from middle of Oct. So, there were not so many students in the university on September. But professors and researchers worked in theirs office, so I could start research. I mainly did research work. My research topic was studying of design methodology and redesigning the device. I studied basic at first, because the topic was not my major in Japan. Once a week I had meeting with my supervisors. Since I did not speak English Fluently and know technical-term, it was always difficult to explain what I did in English. I learned English about this field as well as my research topic through my research work at TUB. I lived in a dormitory where many students from all over the world lived. Almost all students speak English, but there were so many students who cannot speak English. They can speak only German. So it was difficult to communicate with them. But in technical University almost everyone can speak English. When I went out (for example supermarket, restaurant, train station), some people could not speak English, so I had problem about communication there too. In other dormitory where DeMaMech students lived, everyone can speak English and they ware so friendly. So I sometime went to the dormitory, and had a dinner or party. I think it is easier to live in Berlin than in Japan, because everything costs less in Berlin than in Japan. But, it is only about Berlin, Denmark was not so at all.

I moved to Denmark the end of December, and I have studied at technical University of Denmark on January. I took an intensive course about metal casting, injection moulding, casting and bulk forming. In this lecture I mainly did exercise with simulation soft. I lived in dormitory (Campus Village) in Denmark. There were students from various countries. In my dormitory (container), there were so many Chinese people. In Denmark, everything is much more expensive than in Japan. So it was hard to live in Northern EU. I don't want to go to or live in northern EU any more.

6. Suggestions

We had to go to 2 countries in this project for 5 months, but this system was not good for us at all. We could not study enough, because we didn't have enough time. Five month was good enough for seeing or traveling around EU, but not enough for studying after all.

7. Summary

I studied at T.U.B. and D.T.U. In T.U.B., I learned design methodology. In D.T.U., I learned numerical simulation. I could improve my English skills and could learn German.