Cécile Le Cocq

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Pre- Thesis Proposal

As a senior in course 6, I have been looking for a possible MEng project to work on for next year. I was excited to look in the Research Laboratory of Electronics (RLE), for my interests lie heavily in the signal processing of electrical engineering. RLE was where I found Professor John Wyatt. As a former instructor of mine in 6.011, I already knew him to be a friendly professor, and since 6.011 was a class I enjoyed and did well in, I decided to ask him for an MEng project. Because of a trip of his to Japan, followed by a messy computer crash in his office which ate up my emails I sent him, I am not as far in defining a thesis project as I would have hoped. Yet from the last meeting with him, I am very hopeful in defining a precise project with him during IAP. Meanwhile I have looked into his research in the Circuits and Systems Group in RLE along with the Retinal Implant Project.

RLE's Circuits and Systems group conducts research on very-large-scale integration (VLSI) systems design and related areas. Their research includes development of an interactive learning environment for students of VLSI design, research into vibration-to-electric energy conversion for the use in self-powered VLSI systems, development of computational prototyping tools and techniques for a wide range of design applications, development of implantable retinal prostheses for the blind, and research into neuromorphic VLSI systems, an area of microelectronics that is inspired by biology. Prof. John Wyatt and research affiliate Dr. Joseph Rizzo direct the Retinal

implant Project, a Harvard-MIT collaboration. This project seeks to develop a surgically implantable retinal prosthesis to restore some vision to patients with two common types of blindness, *Retinitis pigmentosa* and age-related macular degeneration. A simple microelectrode array of activated iridium will be implanted on the front surface of the retina, bypassing degraded rods and cones and transmitting visual information directly to the ganglion cells and the optic nerve. The current efforts are at the proof-of-concept level, with ongoing trial animal implantations, and temporary implantations in human volunteers have just started. This project makes use of VLSI technology in image processing microchips which will prepare the visual data for the stimulating array.

The technology that I am interested in this group would be dealing with the image processing. In the current state of the project, prototypes of the chips have been made but not their final version. This means I would probably be involved in building an improvement of the current prototype or with adding on to it. The precise areas which are in need of improvements is still somewhat unclear to me, though I believe they are mostly in reducing the energy requirements and improving the processing of the image to obtain the best quality image possible. Prof. Wyatt did mention that a project in this group would be more building and less research. This might fit better in the small time period of an MEng.

Prof. Wyatt also mentioned a completely unrelated problem he was interested in. This is apparently a follow up to a project worked on by a previous MEng student a few years ago. I couldn't find any information about on his web site so I look forward to talking to him further about this so that I may decide which of the two I prefer. The project involves solving a simple inverse problem. Instead of analyzing a system to

understand what it will output, this involves reading output from an unknown system to try and understand what is in the system. The precise problem from what I understand so far involves current running through a plane with different thickness which gives different resistivity. By analyzing the path of the current you can figure out the different resistivity and hence thickness of the plate. He mentioned it was a problem that some industries are very interested in. Because our time restrictions, he wasn't able to give me much information about it. He mentioned it relied heavily on MATLAB and having an interest in linear algebra. From the little that I know about this specific project, I believe I might have some interest in it but I will have to wait until our next meeting to learn more details so that I can make up my mind about it.

With either of these two areas, there is a definite demonstration at the end of my thesis. In the first case, with a project involving the retinal implant, I would build a circuit and be able to show the specific improvements when compared to the original prototype. In the second group, I would demonstrate a method of analyzing an unknown system and giving as much information as possible on the system.

The funding for either of these two projects might be a little difficult. There is no funding set up for a new MEng student in either of the projects. When discussing funding with Prof. Wyatt, he sounded as if funding was not impossible in either case but also not guaranteed. I should have two classes left to take during my fifth year. This makes being a TA for at least one term a possible, though of course not preferred, choice. I will have to take this into account when deciding the size of the project I choose to pursue during IAP.

The risks in this project are therefore mostly in the funding. With the two very different types of project I am quite confident in finding a project to my liking. I hope to have a definite project by IAP. During IAP I can finalize a project idea and get more of an idea about the possibility of funding. During the following Spring term I hope to UROP in the group and get to know the material that I will be dealing with. I will also be taking relevant classes, which count towards my MEng. If funding seems very unlikely, I might decide to fit another course 6 class instead of a UROP so that I may have more time to TA and do my research during my 5th year. I will be at MIT during the following summer and do a large part of my research and design of my project. During fall term and IAP of my fifth year I will build and debug my project. By spring term I will tie up loose strings of my project and write my thesis. Next step is… graduate! My current plan is to work abroad the following year through an MIT program. This will hopefully take up less time to organize than real job searching or graduate school applications and give me more time for my research during my 5th year at MIT.