CMU-Portugal Undergraduate Internship Report - Spring 2015

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In this report I summarize my experience and work carried out while participating in the CMU-Portugal undergraduate internship program, from April to July 2015.

During my 3 months internship at Carnegie Mellon University, I was hosted and supervised by Professor Manuela Veloso, and I had the opportunity to join the CORAL group, at the Computer Science Department.

I was integrated in a project whose goal was to develop an approach to enable a robot to perform personalized dressing assistance to humans. Given a dressing task, the solution we proposed for this problem finds a trajectory involving manipulator motions and also user repositioning requests. Specifically, the solution allows the robot and user to take turns moving in the same space and is cognizant of the user's limitations. To maximize safety, the manipulator uses a motion model of the user to evaluate the safety of trajectories before executing them. A vision module monitors the human's motion, determines if he is following the repositioning requests, and infers mobility limitations when he cannot. The learned constraints are used during future dressing episodes to personalize the repositioning requests. The contributions of this work include a turn-taking approach to human-robot coordination that considers safe trajectories for dressing a user, and a vision module capable of learning user limitations. This approach was tested and evaluated on a Baxter manipulator.

In particular, my main task was to develop the computer vision sub-system, which was at the core of the contributions, namely, to enhance the human-awareness and safety of the robotic assistant, specially during the cooperation between the human and robot.

Up to this point, the aforementioned project resulted in a paper that is currently under submission for the *2015 International Conference on Social Robotics*. Due to the success of this project, further collaboration is already ongoing to work and extend the current solution. As a result, we have planed future publications to other venues and journals.

My evaluation of this experience is absolutely satisfactory. Since the early days of my stay I always felt welcome and integrated in the CORAL group. Besides the technical work for the aforementioned project, I attended the weekly group meetings as well as other seminars and talks on topics such as robotics, artificial intelligence, optimization and game theory. Thus, what I have learned during this period is not limited to the research topic of my work plan.

Near the end of my visit, I had also the opportunity to present my Master's thesis in a Research Seminar organized by the Energy and Information Systems group, from the Electrical and Computer Engineering Department. This was an excellent event to share my work and obtain insightful feedback from peers.

Overall, this internship has been an extremely valuable and engaging experience due to the integration in a leading research lab with cutting-edge technology, such as the Google Glass and the Baxter robot. Moreover, I had a first hand experience at the fast-paced and engaging research process that takes place at a top university such as CMU. Furthermore, I was included in the process of devising and writing scientific publications, for which I am grateful.

This experience definitely opened new perspectives for me, in terms of internationalization and networking with researchers in my field of research. I am sure this internship will play a cornerstone role in my curriculum to trigger future collaborations with faculty members from CMU.

Finally, I would like to thank Professor Manuela Veloso and Professor João Paulo Costeira. This highly rewarding experience would not have been possible without their commitment and support.