

Faculty Exchange Program Report – Spring 2016**Name:** Inês Portugal**Institution:** University of Aveiro, Department of Chemistry & CICECO**Period of Visit:** January 9 – May 31, 2016**Host at CMU:** Professor Ignacio E. Grossmann
Department of Chemical Engineering

The work plan comprised two interacting parts aiming the improvement of teaching and research skills on the area of *Software Engineering for Large-Scale Dependable Systems* with a special focus on Process System Engineering (PSE) tools for the Biorefinery concept.

In terms of Teaching, I attended one undergraduate 6-units course on *Optimization Modeling and Algorithms* (CHE 06-462) and a graduate 12-units course on *Advanced Process Systems Engineering* (CHE 06-720). Overall, now I have a better insight about the teaching/learning approaches at CMU which involve classical recitation classes and exams, strongly complemented by homework assignments and projects supervised by Teaching Assistants (TA). I spoke to a few PhD students to understand their TA assignments (usually 5 h per week over 3 semesters), and to understand the several stages of the PhD program from the Qualifier Exam at the end of the first year, the Thesis Proposal examination at the end of the second year, and the PhD defense typically 4-5 years later. I had the opportunity to attend one Thesis Proposal and three PhD defenses of students working in the PSE group. I talked with professors to understand the research advisor selection process, the fellowship and project funding system, and some other aspects of the Chemical Engineering undergraduate and graduate programs at CMU.

In terms of Research, I was integrated in the Center for Advanced Process Decision (CAPD), a consortium involving 20 companies (mostly large chemical and petroleum industries), 5 faculty members, about 25 graduate students and 8 postdocs and visitors. I attended the CAPD annual review meeting held from March 6 to 9 (2016), including the panel discussion about PSE challenges in the pharmaceutical industry and the special sessions on Energy Systems Initiative (ESI) and Enterprise-wide Optimization (EWO). I participated in the poster session with the work *Integrating Bioethanol Production in a Hardwood Sulphite Pulp Mill*. This work was carried according to plan and included: i) gathering relevant process and environmental information concerning the individual bioprocesses, the biomass feedstock and the possible products from Hardwood Sulphite Spent Liquor (HSSL); ii) definition of the HSSL biorefinery superstructure of alternatives; iii) modeling of the corresponding processes and units; iv) formulation of the optimization problem of the superstructure of alternatives as a MINLP problem regarding economic and sustainability criteria. The last steps are still ongoing in order to explore different scenarios. I met on a weekly basis with Ignacio Grossmann to discuss this work and particular issues related to modeling and optimization of complex systems.

In addition, I attended the CAPD Short Course on *Optimization Modeling, Conceptual Design and Integrated Process Operations* (May 4 - 11, 2016), several ChemE seminars and the PSE group meetings/seminars on a regular basis. This is one of the aspects I consider unique, the large number of seminars delivered by external academic and industrial partners exposes the

students, from early stages, to the importance of communication and collaboration among the various stakeholders. Furthermore, it provides the chance to have different perspectives on the same subject. Another unique feature is the pursuit of excellence and the recognition of success of faculty members, students, and alumni (the ChemE newsletter, CMU-ChemE twitter feed, and TV screen at the Doherty Hall entrance convey the information). Finally, the strong relationship between academia and the CAPD industrial partners is noteworthy, with the former pursuing fundamental research for oriented applications in product/process design, and the later providing financial support for research and PhD students, paid summer internships for graduate and undergraduate students, and employment opportunities for PhD graduates.

In view of the general objectives of the CMU-PT Faculty Exchange program, I consider the main goals were achieved and hope to implement some of the learnt strategies at my teaching courses and to develop the research cooperation with CMU in the near future, especially with Professor Ignacio Grossmann and co-workers.

To finalize, I would like to express my gratitude to: Ignacio Grossmann for hosting my stay at CMU, guiding my first-steps through Process System Engineering, and for the warmth welcome to his research group; the ChemE Department and OIE administrative staff for assistance during my stay; the CAPD students and researchers for their comradeship; Paula W. and family for their hospitality; CMU-Portugal and Fundação para a Ciência e a Tecnologia (FCT) for financial support and approving my participation in the CMU-PT Faculty Exchange Program; the CMU-Portugal staff for their kindness and support before and during my stay; University of Aveiro for sabbatical leave; the Chemical Engineering group and Chemistry Department of UA for backup; and last, but not the least, to my family and friends for being there.

**Inês Portugal,
Pittsburgh – May 17, 2016**