PhD Project Proposal

School of Electronics, Electrical Engineering and Computer Science

& ECIT Global Research Institute

Proposed Project Title: Safe Cobotics for Industry 4.0

Principal Supervisor: Dr Nikolaos Athanasopoulos **Second Supervisor:** Prof Sean McLoone

Project Description:

Modern cyber-physical systems are increasingly difficult to control today for two reasons; First, they are large scale, have complex dynamics and live in both the continuous and discrete worlds: For example, the production line in a typical factory consists of many interconnected subsystems, and requires several distributed computing components and a network of sensors/actuators to be controlled. Second, the performance specifications and objectives have become themselves extremely complicated as well. For example, in a logistics warehouse, consisting of many autonomous mobile robots and manipulators, the goal is to not only move products from a point A to a point B, but to do so in a provably safe way, minimizing energy consumption, implying ultimately real-time communication and collaboration between all autonomous agents involved (mobile robots, manipulators, humans).

An especially timely and critical challenge in Digital Manufacturing, which calls for the development of smart control algorithms, is the safe human-robot collaboration, coined by the term cobotics. This is a prerequisite for the realization of Industry 4.0, as it is needed to realize the factories of the future, with ant/hive-like manufacturing centres that will be able to produce extremely customizable products. The existing solutions for this type of formulations come from several different research fields, however, they are either too simple, thus unable to guarantee an optimal and safe behaviour, or too complicated, thus not implementable.

The proposed project, rooted at the i-AMS centre, aims to use tools from applied mathematics, control engineering and computer science to propose provably correct, implementable controllers for benchmark problems in cobotics. The project will start by building on and adapting recent preliminary results on scalable algorithms for the reachability analysis and control of a large class of hybrid automata. An experimental setup will be also built for benchmarking the performance of the developed research against the state-of-the-art, while the results will also be tested on the facilities of the Northern Ireland Technology Centre.

A 2:1 or higher honours degree in Electrical Engineering or a relevant field (Computer Science, Mechanical Engineering, Applied Mathematics) is essential. A strong mathematical background and programming skills are also desirable.

Contact details

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