Project proposal template
Graduate School studentships
March 2015

Project title	Design, analysis and optimization of a lower limb active controlled prosthesis
First Supervisor	Dr — Demetrios T. Venetsanos
Second Supervisor	Prof. Necip Sahinkaya
School	Mechanical and Automotive Engineering
Other member of supervisory team (no more than three KU supervisors in total)	Dr Yahya Zweiri
Specific requirements beyond 2:1 degree	BEng course in Mechanical Engineering (with 1st), one year of industrial experience or placement. excellent knowledge of CAD, FEA, MatLab, C & Python.

Project summary

(max 4,000 characters)

Due to accidents or serious medical reasons, the lower part of one leg or even two legs may have to be removed after a surgical operation. This amputation results in various difficulties regarding the locomotion of the person having sustained the amputation. In order to compensate the missing limb, it is possible to use prosthesis. The challenge with this solution is that the prosthesis should look, behave and feel like the missing limb. This is a difficult multidisciplinary and multi-objective optimization problem. The proposed PhD will tackle this problem through solving a coupled electromechanical optimization problem. More specifically, multiple experimental measurements at specific locations of the lower limb during a gait cycle, and foot pressure will be taken. From the analysis of these experimental values, the time-trajectory of the measurement points on the lower limb will be determined and used as a reference. Then, a full 3D CAD parametric model of the lower limb will be developed. The CAD model will also accommodate appropriate array of actuators at optimum locations. The objective is to develop control the array of actuators so that the numerical time trajectories match the experimental results. The ultimate goal is to achieve such a match for an optimized design that resembles in the best possible way, in terms of shape and weight, of the missing lower part of the leg. For the layout optimization of the prosthesis, both deterministic and stochastic optimization procedures will be implemented. Within the framework of the proposed PhD, it is anticipated that a fully functional prototype will be manufactured.

The second stage of the PhD proposal involves developing an adaptive force feedback control approach so that the prosthesis could be controlled by the user's motion intentions in real time using neurological signals.