PGTA Project Proposal

Discipline:	Biomechanics and Motor Control
Title:	Computer simulation modelling: Applications to optimal technique and motor learning.
Supervisory Team:	Dr Michael Hiley Dr Sam Allen
Summary of proposed project:	Aims: To develop a torque driven computer simulation model (i.e. driven by muscle activations and muscle force properties) incorporating motor system noise. To apply the model to developing optimisation algorithms which replicate human motor learning. Summary: Computer simulation modelling is a powerful tool in Sports Biomechanics and Motor Control that allows underlying mechanics and control strategies of technique to be investigated. Optimisation is often used in conjunction with simulation modelling, which might take the form of minimising joint torques or some other biomechanical measure, in an expectation that the optimum technique will resemble human performance. Identifying suitable optimisation criteria can provide insight into the techniques adopted by athletes. However, an otherwise optimal technique can be sensitive to small perturbations. As a consequence, optimised technique also needs to be robust to the inherent variation in co-ordination. Constraints will apply when an athlete acquires complex movements. Strength, flexibility, co-ordination precision, motor system noise and the ability to use feedback control will all impact on the solution space within which the athlete will operate. In the initial stages of learning a search for such a solution space will lead to gross changes in technique and variable performance outcomes. Once a successful technique has been found it can then be refined and the solution space can be explored. As the constraints change, for example changing strength, so will the possible solution space. Existing optimisation algorithms can find global solutions for movements, depending on the complexity of the task, within several thousand simulations. However, a human learner can find solutions within several hundred attempts (sometimes even less if physiological constraints do not limit the solution space excessively). Determining how a learner parameterises the co-ordination pattern (technique) in order to enter a solution space within several hundred attempts/simulations will provide insight into how motor learning occurs and produce realistic optimal sporting performances.
Skills/experience/ education required:	Applicants should have at least a 2:1 Honours degree (or equivalent) in sport science (with a large component of biomechanics), physics, engineering, mathematics or a related subject. A relevant Master's degree and/or experience in one or more of the following will be an advantage: computer simulation modelling, 3D motion analysis applied sport science support.
Link to School research theme:	Sport Performance