PhD fellowship in multi-agent control and modelling

Written by P. Chatelain, J. Hendrickx and R. Ronsse

A PhD fellowship in multi-agent control and modelling is open within the Institute of information and communication technologies, electronics and applied mathematics (ICTEAM) at UCLouvain (Belgium). This 4-year fellowship (conditioned by a confirmation exam in year 2) position is offered in the context of the RevealFlight project. RevealFlight is a multidisciplinary project bridging control, aerodynamics, biomechanics and multi-agent systems, with the ambition of re-creating bird formation flight from first principles in order to shed light on their interplay and how it leads to the remarkable energy efficiency of birds. The selected candidate will focus on the bird flight control and collaborate with experts in the other fields. Interactions (including scientific stays) with the international collaborating institutions: ETH Zurich, U Illinois at Urbana Champaign, and UCLA, will be encouraged.

PROJECT FRAMEWORK

The Concerted Research Action RevealFlight (PIs: P. Chatelain, R. Ronsse, J. Hendrickx) aims at shedding light on the efficiency optimization mechanisms deployed by biological flyers, with a specific focus on migratory birds. The efficiency-seeking mechanisms will be sought through the numerical reproduction of flight that includes the morphology, the neuro-muscular configuration and the gait generation. This resulting gait then exploits aerodynamics at the scale of an individual (unsteady lift generation) and at the level of the flock (formation flight). This project thus proposes to synthesize the flight mechanics of birds into a unified framework, combining biomechanical, sensory, aerodynamic and social interaction models, in order to reproduce the flying gaits and the interactions within a flock.

A neuro-mechanical model of the birds will be developed, capturing bio-inspired principles both in the wing biomechanics (e.g. structure and compliance) and in its coordinated control (through e.g. a network of coordinated oscillators). The dynamics of this model will be solved by means a multi-body solver and in turn, coupled to a massively parallel flow solver (an implementation of the Vortex Particle-Mesh method) in order to capture the bird's wake up to the scales of the flock. The study of self-organization phenomena and inter-bird interactions will begin on simple conceptual models, and be gradually extended to the comprehensive models developed during the project. It will aim at comparing the efficiency of flocks of selfish flyers with that of flocks in which collaboration takes place, whether implicitly or explicitly.

JOB DESCRIPTION AND PROFILE REQUIREMENTS

The successful candidate will be in charge of understanding ***the inter-bird interactions*** in the formation. (S)he will in particular develop different models of interactions, bird "social" behaviors and

of optimizing their actions. These will be tested using both simulations and theoretical analysis. The aerodynamic interactions in the formation represent an important challenge, and so do the physical restrictions imposed by bird biology. The first works will be developed on ultra-simplified aerodynamic and bird models. More complex models, developed in part by other members of the project, will gradually be included. These include high fidelity computational fluid dynamic models.

We are thus seeking candidates with a Master's degree in disciplines related to multi-agent systems (e.g. electrical engineering, applied mathematics etc.). Good programming skills and/or experience in machine learning are a plus. Good communication skills are further required in this project, due to its collaborative nature. The successful candidate will interact with experts in fluid dynamics and biomechanics during the project, but his/her work will focus on the multi-agent systems aspects. Hence no expertise in the former fields is required.

WHAT WE OFFER

- a highly dynamic and multidisciplinary working environment in an international university town
- a challenging and high-visibility research topic that involves intensive national and international collaborations
- an implication in world-leading research groups in control , computational fluid dynamics and biomechanics and an access to state-of-the-art modelling tools
- competitive salary and social benefits

We encourage applications by women as we acknowledge their under-representation in research positions and, in particular, in the engineering disciplines concerned in this project. Our research teams already include several female members, at PhD and Post-Doc levels and we maintain an inclusive workplace culture and lead several efforts of promotion and outreach.

HOW TO APPLY

Your application should be sent by e-mail to revealflight@uclouvain.be, with "PhD position MA" as subject. Application should include a motivation letter, full CV, list of publications if any, academic transcripts, and contact information of two references. Short-listed candidates will be contacted for a teleconference, or physical interview.

LINKS

UCLouvain: www.uclouvain.be

Institute of information and communication technologies, electronics and applied mathematics: www.uclouvain.be/icteam

Institute of mechanics, materials and civil engineering: www.uclouvain.be/immc

RevealFlight project: sites.uclouvain.be/RevealFlight

Louvain-la-Neuve: http://en.wikipedia.org/wiki/Louvain-la-Neuve