

ARGUMENTS

Topics and disciplines

In the context of the « Research poles » project, the disciplines covered by this position are:

- D1. Mathematics, physics
- D2. Information technology, intelligent systems

and the transdisciplinary topics, according to the expertise of the successful candidate:

- X1. Health
- X2. Food
- X5. Environment

Strategic importance and innovation potential

One of the open challenges in « this century of biology » is to comprehend the staggering complexity, stochasticity and robustness of living systems using mathematical, physical, computational and biomodeling approaches. An innovative way to tackle these problems consists in adopting multi-scale strategies that extend from the molecule to molecular networks, cells, organisms, disease networks, population dynamics and/or ecology. « Kept separate, these domains cannot lead to an appreciation of life in its full complexity, from the molecule to the biosphere, nor to the generation of maximal benefits to medicine, industry, agriculture, or conservation biology. » [Kafatos & Eisner, Science 303, 2004].

Owing to the recent technological advances, a huge - increasing - amount of quantitative data from high-throughput experimental platforms has become available and is changing the computational strategies aiming to gain insights into the biological world and to design novel applications in engineering. « Computational models are uniquely positioned to capture the connectivity between the divergent scales of biological function as they can bridge the gap in understanding between isolated *in vitro* experiments and whole-organism *in vivo* models. » [Walpole, Papin & Pierce, Annu Rev Biomed Eng 15, 2013].

In order to explore the full richness of the inter-scale connectivity in biological systems, we have to develop new computational techniques, such as improved modeling of biological networks [Vidal, Cusik & Barabasi, Cell 144, 2011], integration of data across various spatial and temporal scales [Walpole, Papin & Pierce, Annu Rev Biomed Eng 15, 2013], advanced machine-learning techniques [LeCun, Bengio & Hinton, Nature 521, 2015] and stochastic modeling [Tsimring, Rep Prog Phys 77, 2014]. The combined use of these methods will open new avenues to understand complex biological systems and to use such understanding to design new bioprocesses and bio-based systems that will impact and shape the future of our society.

Potential collaborations with ULB/VUB groups

The successful candidate is likely to collaborate with different labs of the Schools of Engineering of and the Faculties of Sciences of ULB and VUB, in particular in the departments of bioengineering, biomedical engineering, chemistry, physics, biology and informatics.

Moreover, she/he will join the IBsquare - Interuniversity Institute for Bioinformatics in Brussels (<https://ibsquare.be/>), an interuniversity (ULB/VUB), cross-faculty (Medicine, Sciences, and Engineering) collaborative space whose goal is to bring together research groups in and around

Brussels developing or requiring high-level biomodeling, bioinformatics and computational biology expertise.

The groups that have already expressed their interest in collaborating with the successful candidate are:

- Prof. Marianne Rومان (3BIO-BioInfo – Computational Biology and Bioinformatics, Bioengineering Department, School of Engineering, ULB):
Deterministic and stochastic modeling of biological processes, computational biomolecular design, physics-constrained machine learning, biological networks (interactome, transcriptome, variome).
- Prof. Philippe Bogaerts (3BIO-BioControl – Biosystems Modeling and Control, Chemistry and Bioengineering Departments, School of Engineering, ULB): Multi-scale modeling of cell cultures in bioreactors, biological networks and mass balance systems with stochastic variables, metabolic network analysis.
- Prof. Hugues Bersini (CoDE-IRIDIA – Biological networks, Informatics Department, School of Engineering, ULB):
Object Oriented model of cellular systems such as the immune system or the neural system; proposal of a UML-like abstract programming language for the modeling of biological systems; machine learning techniques for preventing and diagnosing genetic and cardiac diseases.
- Prof. Benoît Scheid (TIPs – Microfluidics, Chemistry and Bioengineering Departments, School of Engineering, ULB):
High-throughput droplet microfluidics for single cell analysis; cell manipulation (trapping, sorting, etc.) using microfluidics.
- Profs Geneviève Dupont and Didier Gonze (Theoretical Chronobiology, Science Faculty, ULB):
Modeling temporal and spatial intracellular organization, cell signaling, cell differentiation, modeling the dynamics of microbial communities.
- Prof. Marius Gilbert (Spatial Epidemiology, Science Faculty, ULB):
Biological invasion models, epidemics modeling, livestock trade networks, species distribution modeling.
- Prof. Sophie de Buyl (Applied Physics Group, Departments of Physics and of Applied Physics & Photonics from the Faculty of Engineering, VUB):
Dynamical modeling of biological systems from gene regulatory networks and signaling pathways to microbial communities, ascidian early embryonic development, circadian clocks, synthetic biology with non-model organisms.

Note that the latter is expected to strengthen a more general collaboration between the interfaculty and multidisciplinary group of Applied Physics of VUB and the School of Engineering of ULB, at the crossroads of mathematics, physics and biology, for both research and teaching.

Teaching

The successful candidate is expected to have a strong expertise in applied mathematics or physics and thus to be able to teach some of the bachelor courses in mathematics and physics of the School of Engineering, whose titular professors are leaving in the next five years, and to motivate and interest the students, for example by presenting targeted applications borrowed from her/his field

of expertise. In particular, he should be in charge of the General Physics course for students in BA1 Bioengineering.

She/he will also contribute to different master courses of the School of Engineering (ULB/VUB), either by replacing titular professors on leave or contributing to existing courses and enriching them with her/his research topics. According to her/his specific expertise, the contributions will be in the fields of dynamical and stochastic modeling, biophysics, molecular modeling, machine learning and/or bioinformatics in the chemistry, bioengineering, physics, biomedical and informatics departments. This will be discussed with the current titular professors.

Integration

The successful candidate will join the 3BIO lab, which is part of the bioengineering and chemistry departments of the School of Engineering. The system administrator and secretary of 3BIO will be shared with the new academic, and the computer clusters, servers and software will be put in common. She/he will also become a member of the IBsquare - Interuniversity Institute for Bioinformatics in Brussels.

Funding opportunities

Many funding opportunities are attached to this position, such as (those indicated by a « * » depend on the specific research subjects of the candidate):

- F.R.S. – FNRS: FRIA, PDR, MIS, EOS, Télévie* projects.
- Walloon Region: First, BioWin*, Wagraim* or GreenWin* projects
- Innoviris: Doctiris, Team Up, ...
- EU-funded projects: ITN, Feder, ERC, ...
- ARES-CDD and WBI: Cooperation and development projects

FICHE ADMINISTRATIVE

qui doit impérativement accompagner la vacance

n° de vacance : 2017/Axxx

Domaine : (liste Paysage)

Discipline : (au choix)

Poste(s) au cadre : 17-x-xxx-xxx (x) (x.xx ETP) / poste SAP

Références CoA : <Greffé>

Rattachement Enseignement : Département/Service (Mnémon + intitulé)

Rattachement Recherche : Centre de recherche/Unité de recherche (Mnémon + intitulé)

EURAXESS SPECIFIC INFORMATION

Main Research Field : (cf liste EURAXESS)

Sub Research Field : (cf liste EURAXESS - facultatif)

Required educational level: Phd Degree in (Degree Field – voir liste domaines EURAXESS)

Required Languages :

Français : (basic – good – excellent – native)

English : (basic – good – excellent – native)

'autre langue' : (basic – good – excellent – native)

Type of contract : temporary

Hours per week : 38

Required Research Experiences : (domaine – voir liste EURAXESS) : (nombre d'années d'expérience)

Researcher profile : Early stage researcher (0-4 years)

Experienced researcher - R3 (4 – 10 years) (vous pouvez laisser les 2 profils si vous le souhaitez)

Additional requirements :

[texte libre où l'on peut renseigner les domaines et disciplines non disponibles dans les listes Euraxess par exemple]