Polytechnic University of Valencia
Applied Physics Department

Integration of resource allocation within a multi-objective framework for simulation of genome-scale metabolic models

Our Systems Biology research group at the Polytechnic University of Valencia is developing the first multi-objective algorithm that can cope with constraint-based models, such as genome-scale metabolic models, while seeking for optimisation of several objectives simultaneously. It is a differential evolutionary algorithm capable of dealing with multi-objective functions such as growth (without a strict biomass equation requirement), metabolic fitness and production of target metabolites, among others, while incorporating fluxomic experimental data, if available. The algorithm is able to find multiple solutions in a trade-off manner between all competing objectives. Moreover, our proposed framework is able to cope with any non-linear restriction, such as flux ratios or predefined cost-functions, capacity not owned by the already published linear algorithms such as the well-known Flux Balance Analysis (FBA) and derived methodologies, since they can only obtain mono-objective solutions under linear constraints, depicting a simplified image of the cell.

The student will incorporate cell resources needed for the metabolism, such as ribosomes or enzyme costs, into the actual multi-objective framework. This work will be inspired by the Resource Balance Analysis (RBA) developed by Anne Goelzer from INRA, Centre Jouy-en-Josas. The work will be performed on the model organism E. Coli, where the impact of cell resources on metabolic fitness and target production metabolite will be studied under the umbrella of a real multi-objective problem.

Supervisor:
David Fuente Herraiz
divadfu@hotmail.com