

PCOG

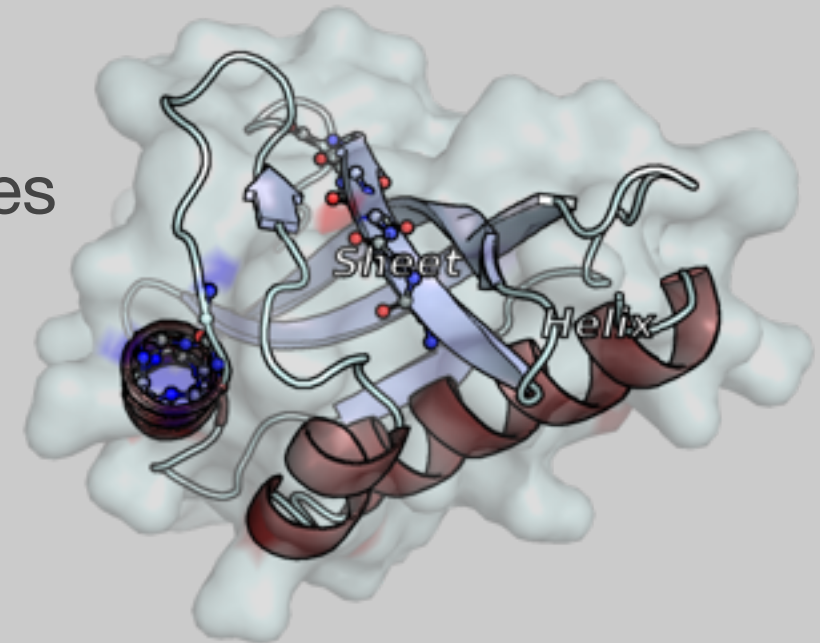
Yearly team meeting



Research Activities

■ EvoPerf – UL/LCSB – 2011/2016

- Evolutionary Computing and Performance Guarantees
- WP3: Decision-theoretic fine tuning of evolutionary algorithms
 - Sune S. Nielsen's PhD defended on February 24, 2016



■ Contributions

- GA with DAO/QC and validation using prediction tool [1,3]
- NK landscape benchmark mimicking the IFP problem [2]
- Preference-based Genetic Algorithm [4]

[1] Sune S. Nielsen, Grégoire Danoy, Wiktor Jurkowski, Juan Luis Jiménez Laredo, Reinhard Schneider, El-Ghazali Talbi, Pascal Bouvry: A Novel Multi-objectivisation Approach for Optimising the Protein Inverse Folding Problem. EvoApplications 2015: 14-25

[2] Sune S. Nielsen, Grégoire Danoy, Pascal Bouvry, El-Ghazali Talbi: NK Landscape Instances Mimicking the Protein Inverse Folding Problem Towards Future Benchmarks. GECCO (Companion) 2015: 915-921

[3] S. S. Nielsen, G. Danoy, W. Jurkowski, R. Krause, R. Schneider, E.-G. Talbi and P. Bouvry: Evolutionary Algorithms for the Inverse Protein Folding Problem, Handbook of Heuristics, Springer, 1-23, 2017

[4] C. F. Torres, S. S. Nielsen, G. Danoy, and P. Bouvry: Preference-Based Genetic Algorithm for Solving the Bio-Inspired NK Landscape Benchmark, Proceedings of the 7th European Symposium on Computational Intelligence and Mathematics, 1-7, ESCIM 2015

[5] Sune S. Nielsen, Christof Ferreira Torres, Gregoire Danoy, and Pascal Bouvry. 2016. Tackling the IFP Problem with the Preference-Based Genetic Algorithm. In Proceedings of the Genetic and Evolutionary Computation Conference 2016 (GECCO '16) - **Best Paper nominee**

Bioinformatics (cont'd)

■ Clustering in huge graphs

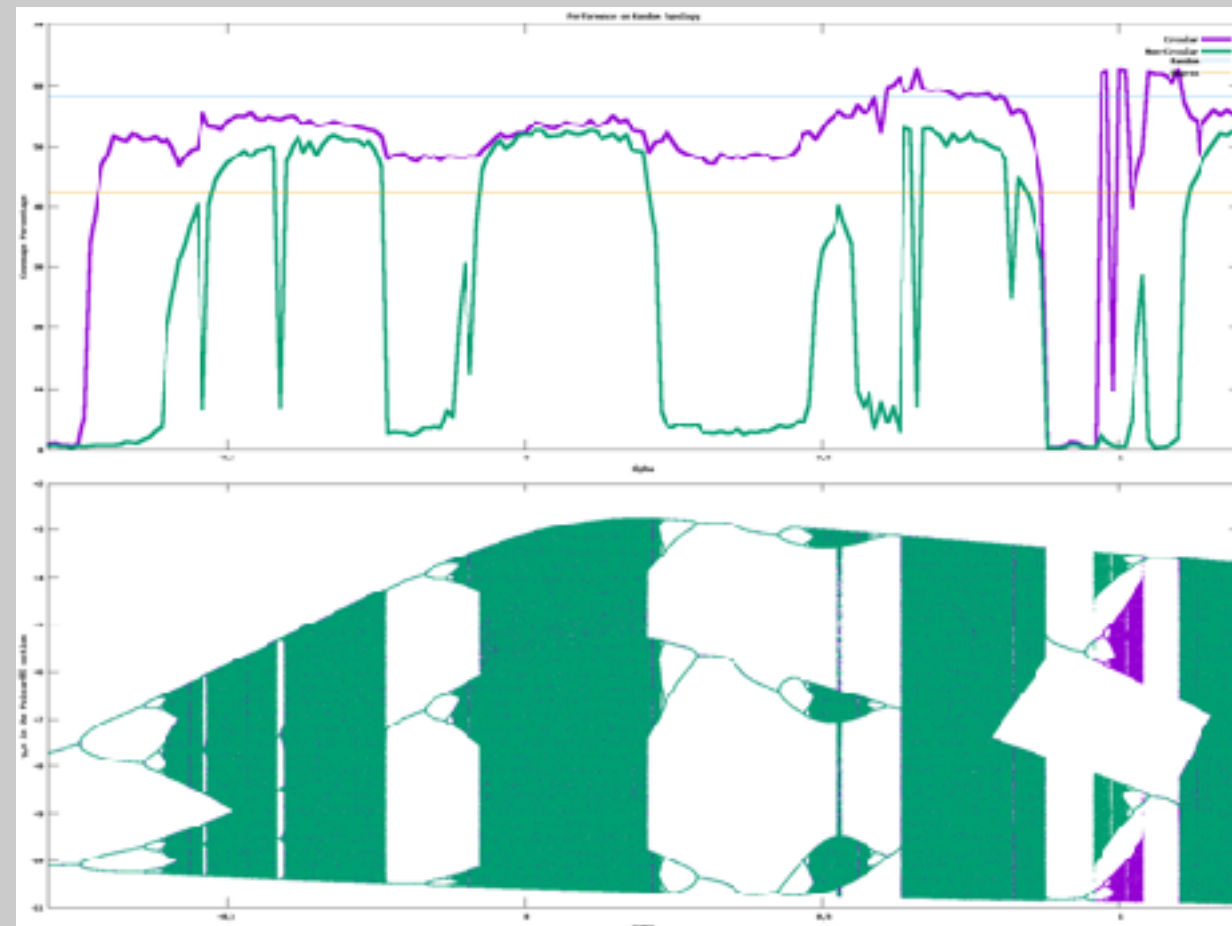
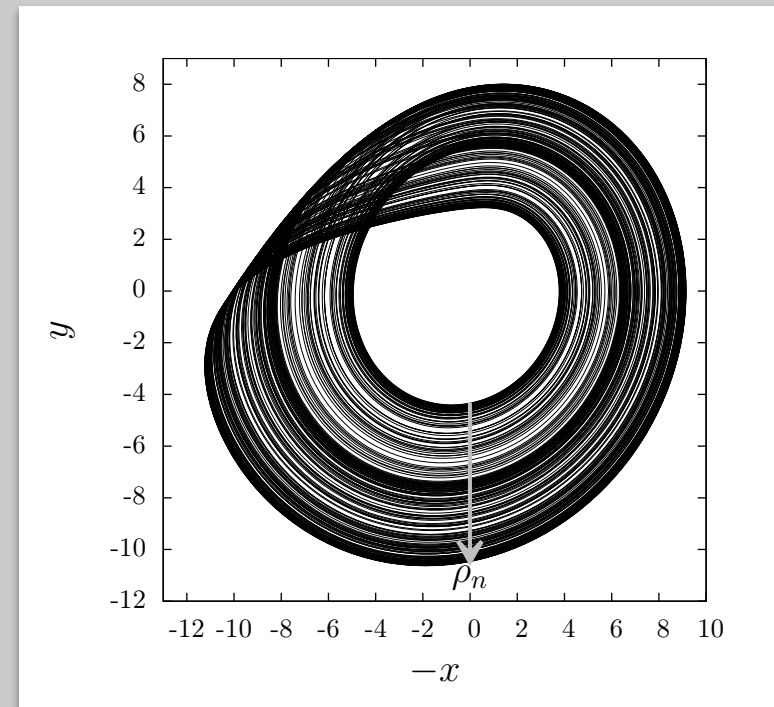
- PhD of Boonyarit
- Collaboration with LCSB (Marek)

■ Current objective

- Memory-less Graph traversal

■ Current approach

- Chaotic exploration



Bi-level Optimisation

■ CARBON

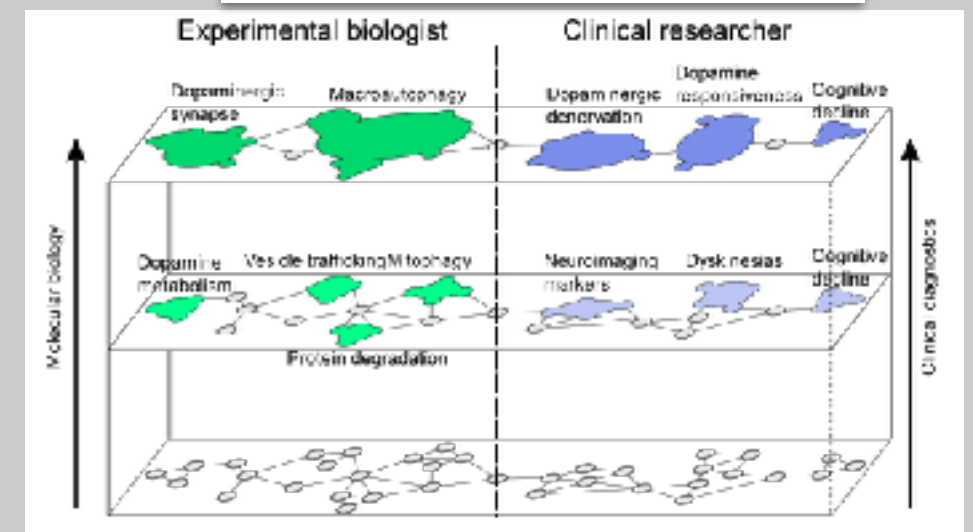
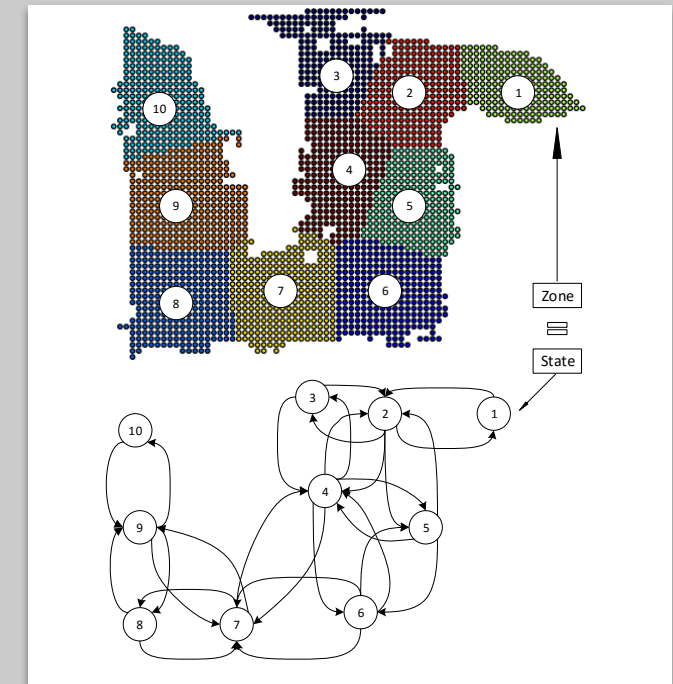
- Coevolutionary Hybrid Bi-level Optimization
- AFR PhD of **Emmanuel Kieffer**

■ Bi-level problem

- Two decision makers and iterative games
- The second level is parametrized by the choice of the first level

■ Applications

- Biological Data Clustering (PD map) - LCSB
- Multi-level UAV swarms mobility optimisation [10]
- Cloud Brokering optimisation [8,9]



[6] Emmanuel Kieffer, Mateusz Guzek, Grégoire Danoy, Pascal Bouvry, and Anass Nagih. 2016. A Novel Co-evolutionary Approach for Constrained Genetic Algorithms. In Proceedings of the 2016 on Genetic and Evolutionary Computation Conference Companion (GECCO '16 Companion)

[7] Emmanuel Kieffer, Grégoire Danoy, Pascal Bouvry, and Anass Nagih, Co-evolutionary approach based on constraint decomposition. In Proceedings of the International Conference on Metaheuristics and Nature Inspired Computing (META 2016)

[8] Emmanuel Kieffer, Grégoire Danoy, Pascal Bouvry, On Bi-level approach for Scheduling problems, New Challenges in Scheduling Theory Seminar, 2016

[9] Mateusz Guzek, Jędrzej Musiał, Emmanuel Kieffer, Grégoire Danoy, Shyam S. Wagle, Pascal Bouvry, and Jacek Blazewicz, Cloud Brokering with Bundles: Multi-Objective Optimization of Services Selection, IEEE Transactions on Services Computing (submitted)

[10] Emmanuel Kieffer, Grégoire Danoy, Pascal Bouvry, and Anass Nagih, Hybrid Mobility Model with Pheromones for UAV detection task, in Proceedings of the IEEE Symposium Series on Computational Intelligence (IEEE SSCI 2016)

■ ASIMUT project (03/2015 - 02/2017)

- Aid to Situation Management based on MUtlmodal, MultiUAVs, Multi-level acquisition Techniques
- First EDA project in Luxembourg

■ Design, optimisation and validation of mobility models

- Coverage of surveyed area
- Connectivity preservation of the UAVs
- Randomness of the surveillance movement
- Energy conservation

■ Collaborations

- University of Bordeaux (FR)
- Fraunhofer IOSB (GE)
- Thales Systèmes Aéroportés SAS (FR)
- Fly-N-Sense (FR)



Chaos in UAV Swarms

■ Work with Martin Rosalie

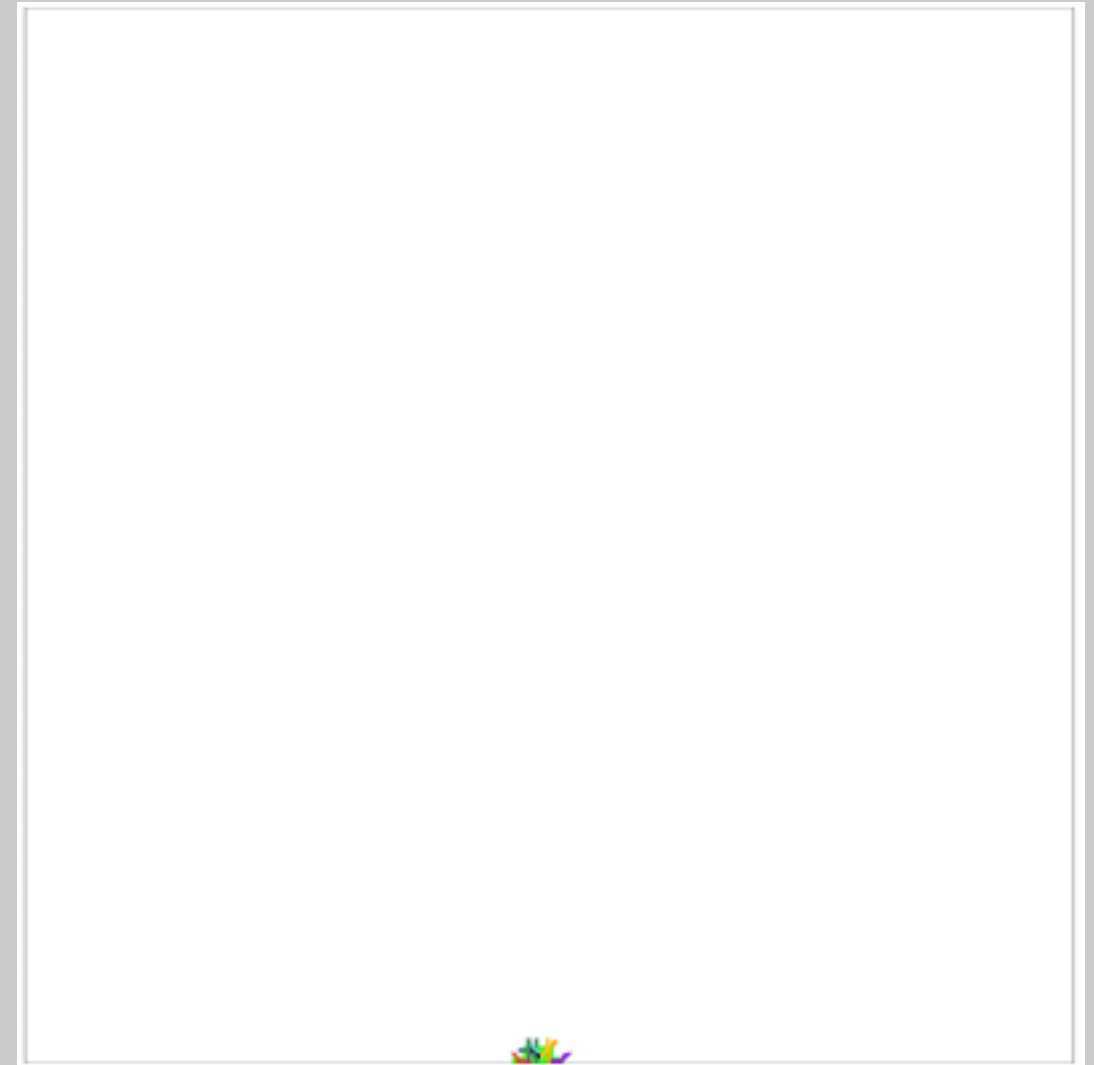
- Using Chaos theory for UAV Swarm mobility management/optimization

■ Several models proposed and compared for surveillance

- CROMM - Chaotic Rössler Mobility Model [11]
- CACOC: Chaotic Ant Colony Optimization for Coverage [11]

■ Next

- CACOC + flocking behavior



[11] Martin Rosalie, Gregoire Danoy, Serge Chaumette, Pascal Bouvry, From Random Process to Chaotic Behavior in Swarms of UAVs, in Proceedings of the sixth ACM Symposium on Design and Analysis of Intelligent Vehicular Networks and Applications (DIVANet'16)

[12] Martin Rosalie, Grégoire Danoy, Matthias R. Brust, Serge Chaumette, Pascal Bouvry, Mobility model with flocking for a swarm of UAVs: Application to the coverage problem with connectivity constraints, in 4th AETOS International Workshop on "Research Challenges for Future RPAS/UAV Systems"

[13] Pascal Bouvry, Serge Chaumette, Grégoire Danoy, Gilles Guerrini, Gilles Jurquet, et al.. Using Heterogeneous Multilevel Swarms of UAVs and High-Level Data Fusion to Support Situation Management in Surveillance Scenarios. International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI 2016)

Clustering in UAVs Swarms

- **Work with Matthias R. Brust**

- From SUTD to UL

- **Fractal clustering for UAV swarms**

- Motivation

- More realistic swarm formation: The leader of a swarm is normally not centered in the cluster

- Objective

- Develop a fractal clustering algorithm for UAV scenarios
 - Circumvent the unrealistic geometric shapes and form more natural swarms

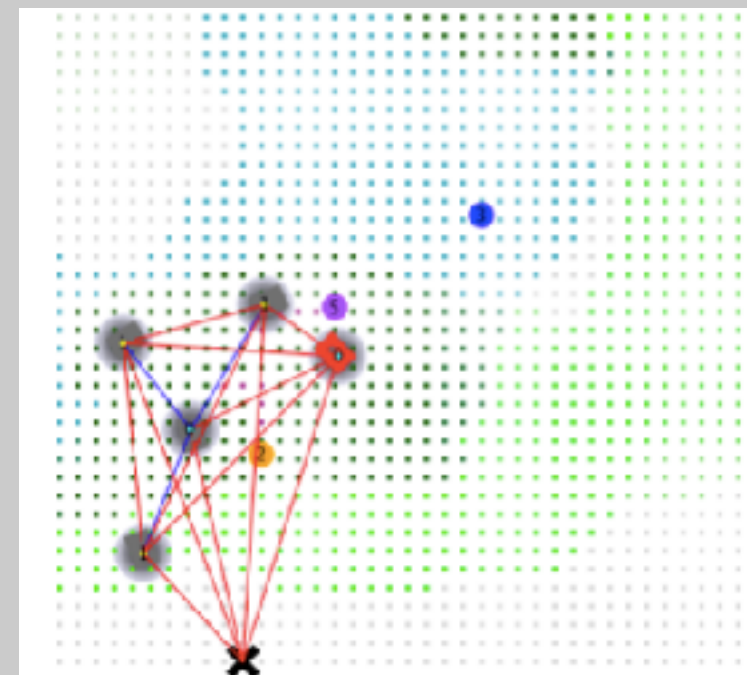
- **Maintaining stable network in UAV swarms**

- Mobility model combining

- Dual pheromone-based mobility model
 - Distributed and online clustering algorithm

- Work with Matthias and MICS students

- Paper in preparation for WoWMoM 2017



Other collaborations

■ University of Cadiz, Spain

- Dr. Bernabe Dorronsoro
- Cooperative Coevolutionary algorithms [14,15]
- UAV swarms mobility optimisation

■ Universidad de la Republica, Uruguay

- Dr. Sergio Nesmachnow
- UAV swarms mobility optimisation - 2 Master students (defended on November 4, 2016)
- Biological knowledge clustering (Parkinson Disease Map) - 2 Master students

[14] A. Atashpendar, B. Dorronsoro, G. Danoy and P. Bouvry, "A parallel cooperative coevolutionary SMPSO algorithm for multi-objective optimization," 2016 International Conference on High Performance Computing & Simulation (HPCS), Innsbruck, 2016, pp. 713-720.

[15] Bernabe Dorronsoro, Arash Atashpendar, Gregoire Danoy, Pascal Bouvry; A Scalable Parallel Cooperative Coevolutionary PSO Algorithm for Multi-objective Optimization. In Journal of Parallel and Distributed Computing (submitted)

Contact information

Dr. Grégoire Danoy
<gregoire.danoy@uni.lu>
Campus Kirchberg
6, rue Coudenhove-Kalergi
L-1359 Luxembourg



Thanks for your attention