

# ***PCOG***

## ***Yearly team meeting***



UNIVERSITÉ DU  
LUXEMBOURG

November 30, 2018

Grégoire Danoy  
[gregoire.danoy@uni.lu](mailto:gregoire.danoy@uni.lu)

<http://pcog.uni.lu>

# Research Activities

---



# Bi-level Optimisation

## ■ CARBON

- CoevolutionAry HybRid Bi-level Optimization
- AFR PhD of **Emmanuel** - **Defense soon**

## ■ Bi-level problems

- Coevolution [3], Bayesian, Heuristics generation [5,6]

## ■ Applications

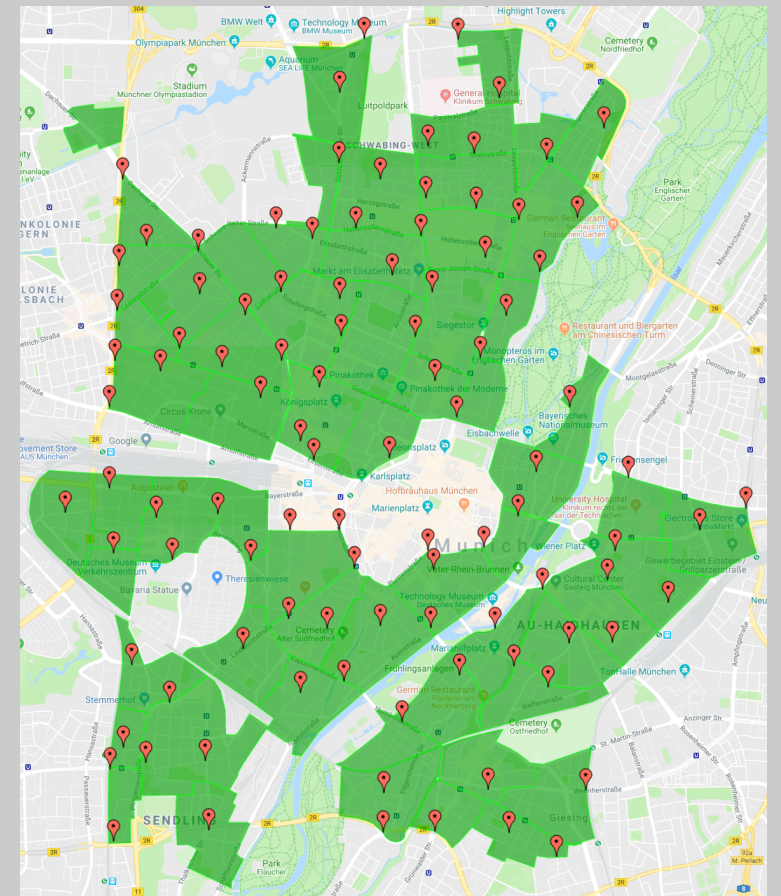
- Constrained problems [4] - MD Knapsack [6] Bi-level problems [5]
- Biological Data Clustering (PD map) - LCSB [1]
- Cloud Brokering optimisation [2]

- [1] M. Ostaszewski, E. Kieffer, G. Danoy, R. Schneider, and P. Bouvry. Clustering approaches for visual knowledge exploration in molecular interaction networks. BMC Bioinformatics, 19(1):308:1–308:15, impact factor: 2.448, 2018
- [2] Jędrzej Musiał; Emmanuel Kieffer; Mateusz Guzek; Gregoire Danoy; Shyam S. Wagle; Pascal Bouvry; Jacek Blazewicz; Cloud Brokering with Bundles: Multiobjective Optimization of Services Selection (to be resubmitted)
- [3] E. Kieffer, G. Danoy, P. Bouvry, and A. Nagih. A competitive approach for bi-level co-evolution. In 2018 IEEE International Parallel and Distributed Processing Symposium Workshops, IPDPS Workshops 2018, Vancouver, BC, Canada, May 21-25, 2018, pages 609–618. IEEE Computer Society, 2018.
- [4] Emmanuel Kieffer; Gregoire Danoy; Pascal Bouvry; Anass Nagih; A hybrid co-evolutionary algorithm for constrained optimization problems; Swarm and Evolutionary Computation; 2017 (to be resubmitted)
- [5] Emmanuel Kieffer; Grégoire Danoy; Pascal Bouvry; Anass Nagih; Automatic Heuristic Generation : application to the Multidimensional Knapsack Problem; (to be submitted to Journal of Heuristics)
- [6] Emmanuel Kieffer, Matthias Rudolf Brust, Gregoire Danoy, Pascal Bouvry, and Anass Nagih. Tackling large-scale and combinatorial bi-level problems with genetic programming hyper-heuristic. IEEE Transactions on Evolutionary Computation, (in review), 2018

# Vehicle Placement Optimisation

## ■ Parking allocation

- Collaboration with Examotive
- Problem Model Modelling (single and multi objective)
- Solving with exact, heuristics and meta [8]
- Solving with hybrid metaheuristic [9]



[7] Boonyarit Changaival; Grégoire Danoy; Dzmitry Kliazovich; Frédéric Guinand; Matthias R. Brust; Jedrzej Musial; Kittichai Lavangnananda.; Pascal Bouvry; Fleet Placement in Station-based Round-trip Car Sharing Service, The journal of transport and land use, 2018 (submitted)

[8] Boonyarit Changaival; Grégoire Danoy; Dzmitry Kliazovich; Frédéric Guinand; Matthias R. Brust; Jedrzej Musial; Kittichai Lavangnananda.; Pascal Bouvry; A Novel Graph-based Hybrid Metaheuristic Algorithm for Vehicle Placement in Carsharing, EVOCOP 2019 (submitted)

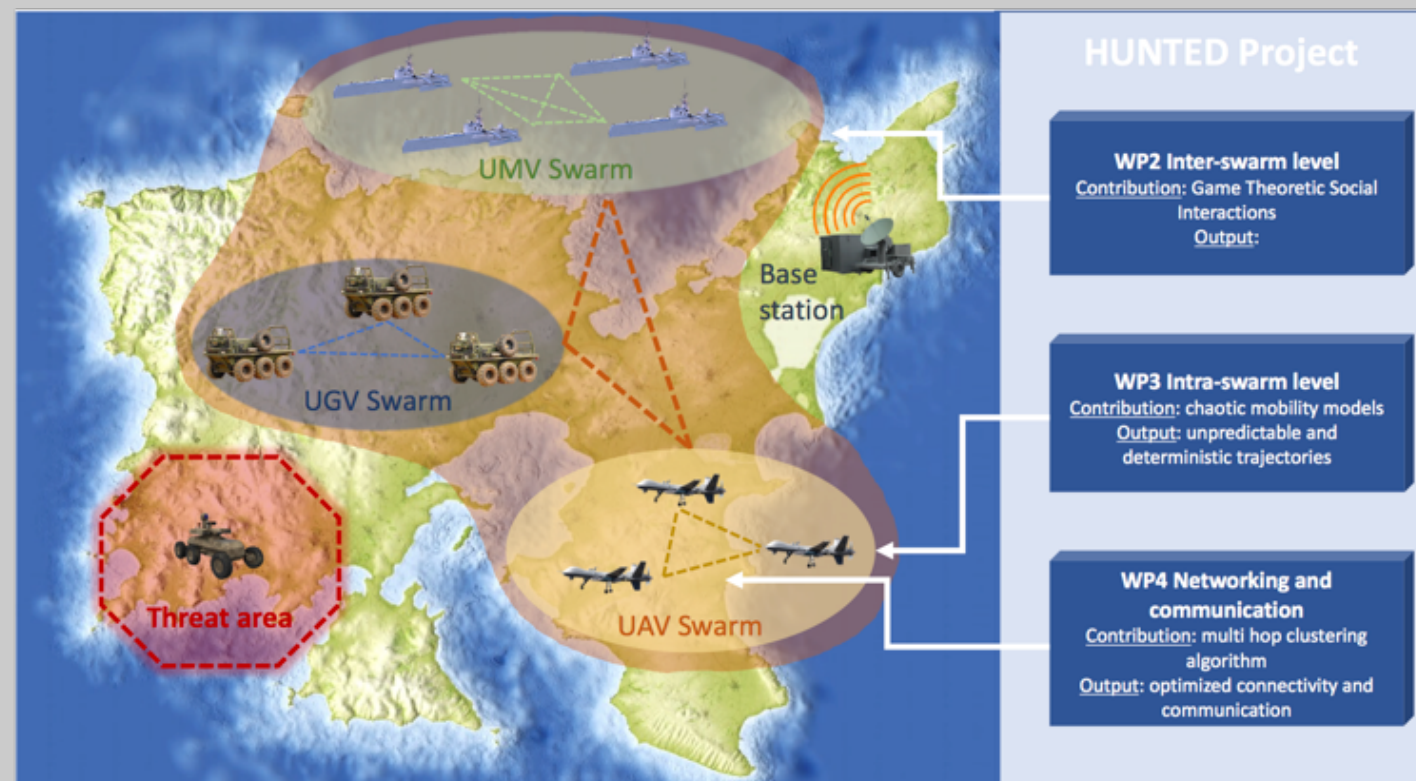
# UAV Swarms

## ■ Heterogeneous multi-swarms of UNmanned auTonomous systEms for mission Deployment

- Funding: ONRG (US Navy)
- Budget: 275k\$ (238k€)
- Duration: 3 years



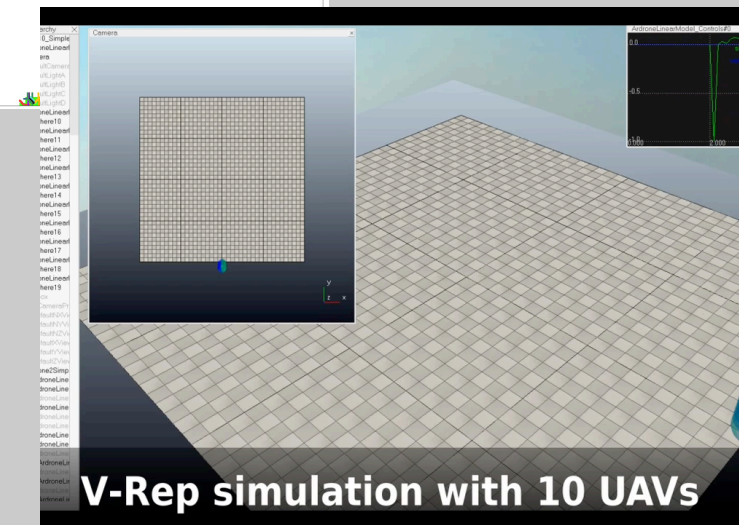
## ■ New generation of mobility models for autonomous and heterogeneous UAS swarms



# UAV Swarms - Mobility models

## ■ Chaos theory

- Mobility models combining ant colony and chaos
- Work with **Martin** [9]
- Hyper-parametric optimisation [10,11]



[9] M. Rosalie, G. Danoy, S. Chaumette, and P. Bouvry. Chaos-enhanced mobility models for multilevel swarms of UAVs. *Swarm and Evolutionary Computation*, 41:36 – 48, impact factor: 3.818, 2018.

[10] E. Kieffer, M. Rosalie, G. Danoy, and P. Bouvry. Bayesian optimization to enhance coverage performance of a swarm of UAV with chaotic dynamics. In *International Workshop on Optimization and Learning: Challenges and Applications (OLA 2018)*, pages 1–2, 2018.

[11] E. Kieffer, M. Rosalie, G. Danoy, and P. Bouvry. Bayesian optimization to select Rössler system parameters in Chaotic Ant Colony Optimization for Coverage (journal paper to be submitted)



# UAV Swarms - Mobility models (and more)

## ■ Hyper-heuristics for swarm behaviour generation

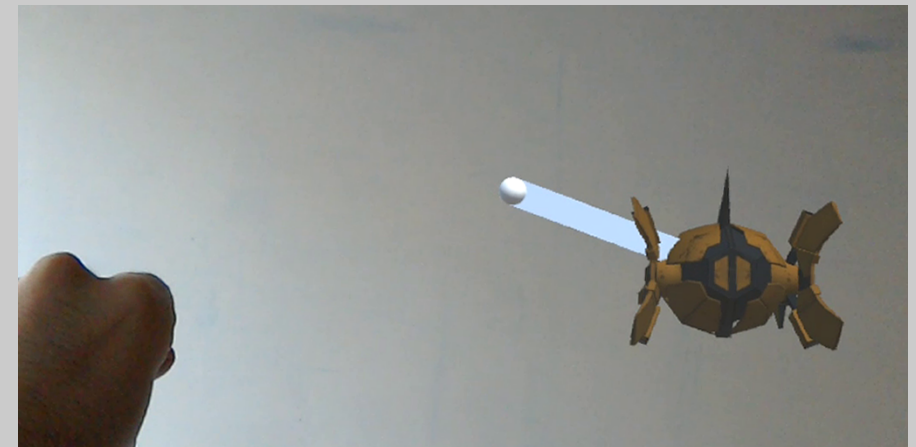
- Master thesis of Gabriel [12]
- AFR PhD proposal under evaluation

## ■ Evolutionary game theory and ant systems

- Master thesis of Matthieu Vuillez

## ■ Using Hololens for UAVs control

- Bachelor work of Youri Falomir



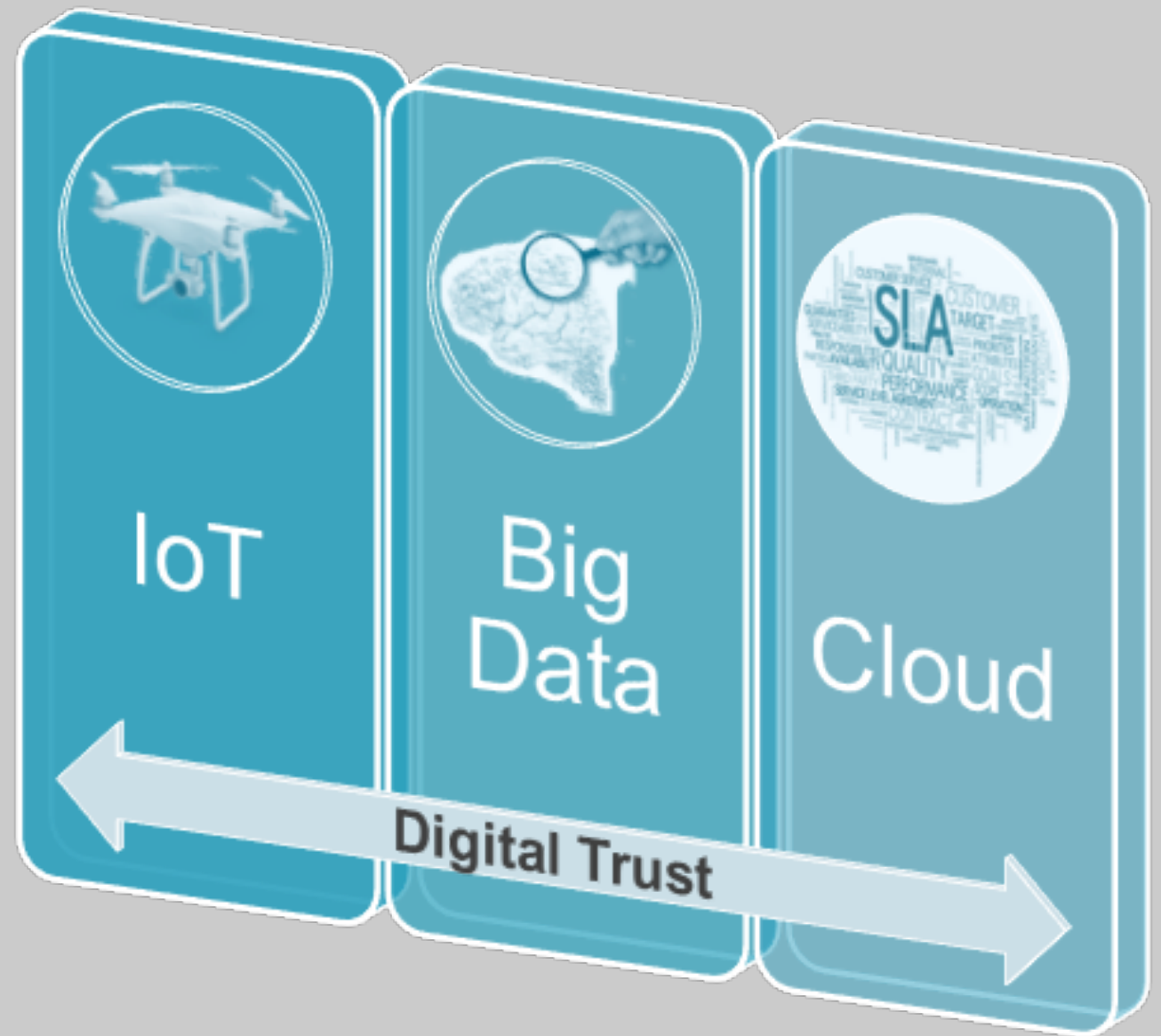
[12] Gabriel Duflo, Emmanuel Kieffer, Grégoire Danoy, Pascal Bouvry; GP hyper-heuristic for the travelling salesman problem, OLA 2019 (accepted)

## ■ Digital Trust in Smart ICT

### ■ Postdoc: Matthias

### ■ PhDs

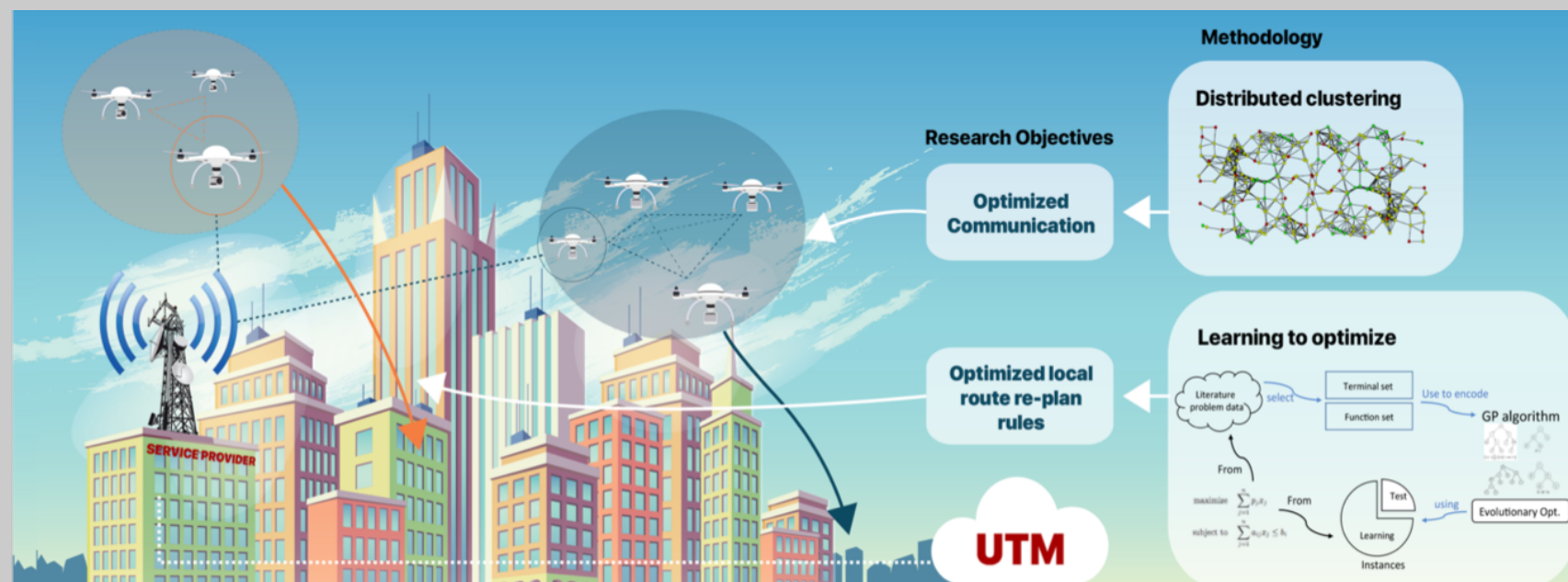
- IoT: Nader
- Cloud: Chao
- Big Data: Saharnaz





## ■ UTM with distributed decision making

- PhD of Nader
- Technical Standardisation in UAVs [12]
- Distributed UTM research [13]



[13] Nader S. Labib, Matthias R. Brust, Grégoire Danoy, Johnatan Pecero, Jean-Philippe Humbert, Pascal Bouvry; On Standardised UAV Localisation and Tracking Systems in Smart Cities, 17th Annual STS Conference, 2018.

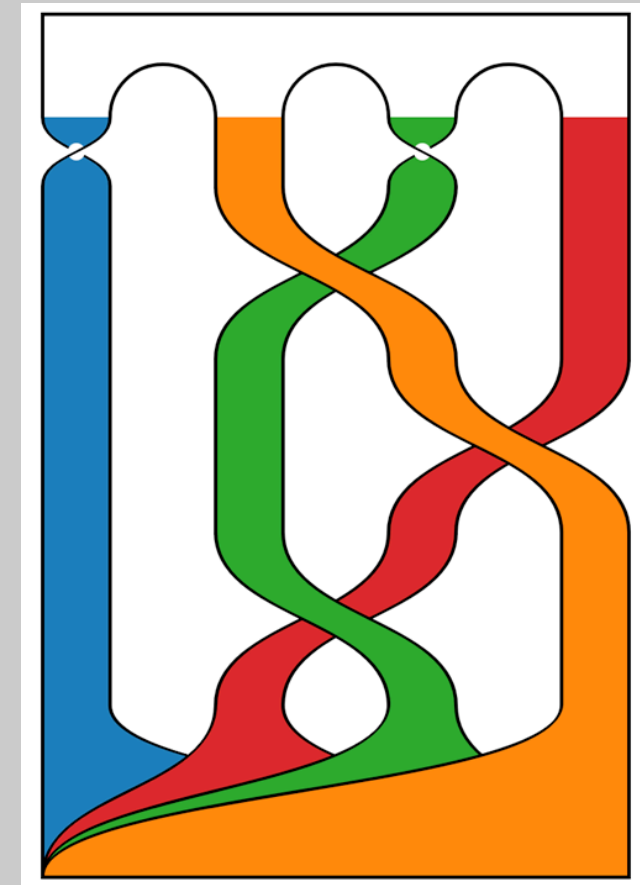
[14] Nader S. Labib, Grégoire Danoy, Matthias R. Brust, Pascal Bouvry; UAVs and the Future of Internet-of-Things: A Survey on Opportunities, Challenges and Future Prospective, (Journal under preparation)

## ■ Visualisation of the template of a Chaotic Attractor

- Validation and Optimisation [15]
- Work with Master students (Optimisation Techniques Lecture)

## ■ Chaotic PSO

- Work with Master students (Optimisation Techniques Lecture)



[15] M. Olszewski, J. Meder, E. Kieffer, R. Bleuse, M. Rosalie, G. Danoy, and P. Bouvry. Visualizing the template of a chaotic attractor. In 26th International Symposium on Graph Drawing and Network Visualization, pages 1–14, 2018.

# Other collaborations

## ■ University of Cadiz, Spain

- Dr. Bernabe Dorronsoro
- Cooperative Coevolutionary algorithms [16]

## ■ Universidad de la Republica, Uruguay

- Dr. Sergio Nesmachnow
- Biological knowledge clustering (Parkinson Disease Map) [17]

[16] A. Atashpendar, B. Dorronsoro, G. Danoy , and P. Bouvry. A scalable parallel cooperative coevolutionary PSO algorithm for multi-objective optimization. J. Parallel and Distributed Computing , 112:111–125, impact factor: 1.815, 2018

[17] M. E. Curi, L. Carozzi, R. Massobrio, S. Nesmachnow, G. Danoy , M. Ostaszewski, and P. Bouvry. Single and multiobjective evolutionary algorithms for clustering biomedical information with unknown number of clusters. Bioinspired Optimization Methods and Their Applications - 8th International Conference, BIOMA 2018 pages 100–112. Springer, 2018.



# Technology Transfer Activities

---

# UAV Swarming Companion Computer

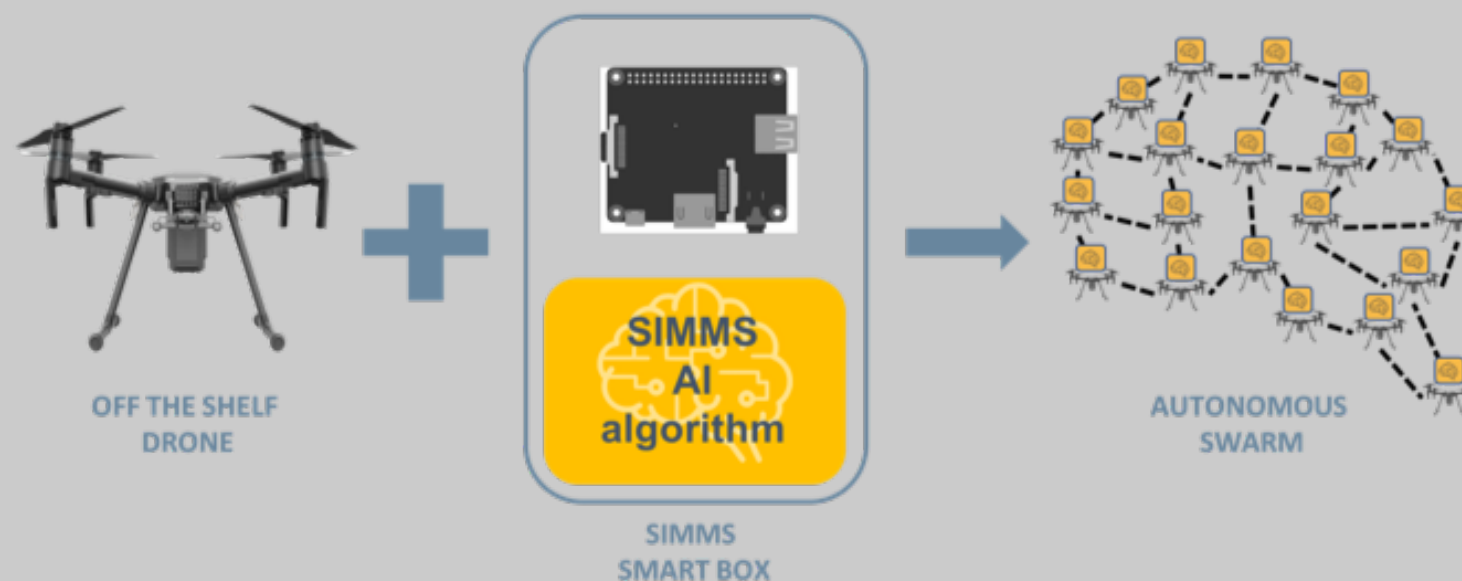
## ■ AURORA - FNR PATHFINDER (5/2018 - 8/2018) - 48 k€

- unpredictable Uav swARms fOr suRveillAnce
- Market survey



## ■ SIMMS - FNR PoC (2019 - 2020) - 200k€

- Swarm Intelligent Mission systeMS
- A.I. powered box bringing swarming capabilities to off the shelf systems



# Dissemination Activities

---



# Dissemination activities

## ■ Scientific events organisation

- **OLA 2019 (Bangkok, Thailand) - January 29-31 2019**
  - International Conference on Optimization and Learning
- **PDCO 2019 (Buenos Aires, Brazil) - May 20 2019**
  - IEEE Workshop on Parallel / Distributed Combinatorics and Optimization (as part of IPDPS)
  - Deadline December 21, 2018



# Contact information

Dr. Grégoire Danoy  
[gregoire.danoy@uni.lu](mailto:gregoire.danoy@uni.lu)  
Office 4.45.050  
Campus Belval  
Maison du Nombre  
6, avenue de la Fonte  
L-4364 Esch-sur-Alzette



Thanks for your attention