A Comparative Study of Local Optimization Methods for Multi-Robot Cooperative Exploration

Advisors – Chroma Team (https://team.inria.fr/chroma/)

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Context

We consider information-gathering problems in a 3D environment, *e.g,* coverage or exploration tasks, involving multiple robots with little or no prior information. To overcome this limitation, we target more specifically online trajectory generations, an interesting and challenging optimization problem. In these scenarios, an analytic expression of the objective function is often unavailable and the optimization needs to be based on the measurements, usually noisy, collected along the mission. One research direction of interest is to choose an approximation architecture of the unknown function, and then explore different stochastic methods including: stochastic gradient methods [4], and derivative-free algorithms [1].

Objectives

The primary goal of this internship is to conduct a review of the literature on different stochastic methods including those previously mentioned. This review should result in a thorough empirical and theoretical comparison among a small selection of methods along different dimensions, including: computational cost, communication requirements and competitiveness with respect to standard solutions, *e.g.,* one method developed in Chroma team [1]. The designed solutions will be then implemented and tested in a realistic simulator (Gazebo) currently maintained in Chroma team.

Localization — Chroma team is bi-localized (Inria Montbonnot center, Grenoble and CITI-lab INSA-Lyon Villeurbanne). The student can choose either site as the main localization, but will need to visit the other site on demand.

Salary — Standard salary for a M2 internship / an internship of the final year in engineering schools.

References

[1] A. Renzaglia, L. Doitsidis, A. Martinelli and E.B. Kosmatopoulos, "Multi-Robot three-dimensional coverage of unknown areas," *The International Journal of Robotics Research,* SAGE Publications, vol. 31, pp. 738-752, 2012.

[2] C. Reymann, A. Renzaglia, F. Lamraoui, M. Bronz and S. Lacroix, "Adaptive Sampling of Cumulus Clouds with a Fleet of UAVs," *Autonomous Robots,* vol. 42, no. 2, pp. 491-512, 2018.

[3] J. Spall, "Stochastic optimization," Handbook of computational statistics, Springer, 2012.

[4] Bertsekas, Dimitri P. (1999), "Nonlinear Programming" (2nd ed.), Cambridge, MA.: Athena Scientific.