A Collective Adaptive Approach to Decentralised k-Coverage in Multi-robot Systems

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We focus on the online multi-object *k*-coverage problem (OMOkC), where mobile robots are required to sense a mobile target from *k* diverse points of view, coordinating themselves in a scalable and possibly decentralised way. There is active research on OMOkC, particularly in the design of decentralised algorithms for solving it. We propose a new take on the issue: Rather than classically developing new algorithms, we apply a macrolevel paradigm, called *aggregate computing*, specifically designed to directly program the global behaviour of a whole *ensemble* of devices at once. To understand the potential of the application of aggregate computing to OMOkC, we extend the Alchemist simulator (supporting aggregate computing natively) with a novel toolchain component supporting the simulation of mobile robots. This way, we build a software engineering toolchain comprising language and simulation tooling for addressing OMOkC. Finally, we exercise our approach and related toolchain by introducing new algorithms for OMOkC; we show that they can be expressed concisely, reuse existing software components and perform better than the current state-of-the-art in terms of coverage over time and number of objects covered overall.

CCS Concepts: • Computer systems organization \rightarrow Self-organizing autonomic computing; *Robotic autonomy*; • Theory of computation \rightarrow Self-organization; • Computing methodologies \rightarrow Distributed programming languages; Self-organization; • Software and its engineering \rightarrow Application specific development environments;

Additional Key Words and Phrases: Location based services, Internet of things, online multi-object *k*-coverage, smart cameras, multi-robot, aggregate computing

ACM Reference format:

Danilo Pianini, Federico Pettinari, Roberto Casadei, and Lukas Esterle. 2022. A Collective Adaptive Approach to Decentralised k-Coverage in Multi-robot Systems. *ACM Trans. Auton. Adapt. Syst.* 17, 1–4, Article 4 (September 2022), 39 pages.

https://doi.org/10.1145/3547145

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1556-4665/2022/09-ART4 \$15.00 https://doi.org/10.1145/3547145

ACM Transactions on Autonomous and Adaptive Systems, Vol. 17, No. 1-4, Article 4. Publication date: September 2022.

The idea and initial effort behind this work originated from the discussion during the GI-Dagstuhl Seminar 18343 "Software Engineering for Intelligent and Autonomous Systems (SEFIAS)." This work has been partially supported by the Italian PRIN project N. 2017KRC7KT "Fluidware."

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