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 macro-level 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** → **Self-organizing autonomic computing**; *Robotic autonomy*; • **Theory of computation** → **Self-organization**; • **Computing methodologies** → *Distributed programming languages*; *Self-organization*; • **Software and its engineering** → *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

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