

Safety in Numbers: Fault-Tolerance in Robot Swarms

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Abstract

The swarm intelligence literature frequently asserts that swarms exhibit high levels of robustness. That claim is, however, rather less frequently supported by empirical or theoretical analysis. But what do we mean by a ‘robust’ swarm? How would we measure the robustness or – to put it another way – fault-tolerance of a robotic swarm? These questions are not just of academic interest. If swarm robotics is to make the transition from the laboratory to real-world engineering implementation, we would need to be able to address these questions in a way that would satisfy the needs of the world of safety certification. This paper explores fault-tolerance in robot swarms through Failure Mode and Effect Analysis (FMEA) and reliability modelling. The work of this paper is illustrated by a case study of a wireless connected robot swarm, employing both simulation and real-robot laboratory experiments.

Keywords: swarm intelligence; swarm robotics; swarm engineering; fault-tolerance; safety; reliability.

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