

Constructions in Swarms: From Simple Rules to Complex Structures¹

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Abstract

Natural collective phenomena, for example the movement of crowds of pedestrians and the impressive nest formations of social insects, provide us with an existence proof that sophisticated constructions may be built by swarms of relatively simple artificial agents. The constructions often appear to have required impressive control and coordination - yet each agent in the collective does not appear to be provided with an internal world model or blue-print for the complete construction. These macroscopic structures emerge as the consequence of interaction of agents, carrying out simple rules based upon the local state of the world, which includes the interaction between agents and the growing structure. In an attempt to understand the underpinning principles of structure formation in collectives of minimal mobile agents the paper focuses on an investigation of automata-like agents in a two-dimensional lattice. All agents start their evolution at the same site of the lattice. Every agent moves at random until it finds a neighbourhood it likes more than other neighbourhoods. The agents form a stationary structure of their immobile bodies. The paper focuses upon the

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