Decentralized K-Means Clustering: Emergent Computation

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A swarm intelligent system is robust, scalable, adaptable, and can efficiently solve complex problems, all through simple behavior. Inspired by biology, swarm intelligent systems, or swarms, utilize emergence, where simple local behaviors distributed across many agents lead to global phenomena, yielding a whole greater than the sum of parts. But the absence of models that quantify emergence, or the lack of an emergent calculus, has challenged swarm engineering. How simple behaviors and interactions lead to complex phenomena is not well understood, let alone developing such behaviors for problem solving. A swarm intelligent solution is presented to a computationally challenging problem with quantifiable results in support of future models of emergence. The swarm intelligent Decentralized K-Means Clustering technique is introduced within the context of rechargeable Mobile Ad hoc Networks (MANETs). Through engineered emergent behavior, cluster centroids relocate to minimize the sum of the squared error between sensors and the nearest centroid, similar to K-means clustering. An agent-based simulation is developed to evaluate the technique, demonstrating the sum of squared error is consistently reduced for both supervised and random scenarios.