AI AgroCraft Robotics: A Neuro-Enhanced Architecture for Autonomous Multi-Agent Smart Agriculture in 2040

Esvanth Mohankumar, Karthick Subramanian Muthukaruppan

School of Computer Science, National College of Ireland, Dublin

Abstract

This paper presents AgroCraft 2040, an architecture for autonomous smart agriculture built around three ideas that rarely appear together in the same system: neuro-inspired edge inference, a decentralised decision layer based on partially-observable Markov models, and a mixed fleet of drones and autonomous ground vehicles (AGVs). Most existing proposals treat these as separate research threads. Here we put them into a single control loop, described as a Dec-POMDP, and we specify the loop with two algorithms: one that runs on each agent and covers perception through to action, and a second that handles task allocation over a shared map of stress events. To check whether the design is actually workable, we also built a small gridworld simulator and compared the proposed allocation against a random baseline for fleet sizes of one to eight agents. The coordinated policy finished every run, was between 13 and 18 times faster in steps-to-completion, and used roughly 15 times less cumulative movement at the larger fleet sizes. These numbers are preliminary but they do suggest the architecture is worth developing further, both in richer simulation and, eventually, in the field.

Keywords: Neuro-enhanced AI, Autonomous Robotics, Smart Agriculture, Multi-Agent Systems, Dec-POMDP, Neuromorphic Edge Computing