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Prof. Bastin Tony Roy Savarimuthu, Dr. Surangika Ranathunga
Guest Editors, Special Issue: "When Foundation Models Meet Multi-Agent Systems"
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Dear Guest Editors,

I am pleased to submit "Emergent Coordination in Multi-Agent Systems via Pressure Fields and Temporal Decay" for your special issue. This paper demonstrates that foundation model capabilities and MAS coordination mechanisms are *mutually enabling*: FMs solve the action enumeration problem that limited stigmergic approaches to discrete spaces, while MAS pressure gradients provide principled criteria for combining FM outputs—replacing ad-hoc voting with quality-based selection. Section 7.7 explicitly articulates this FM-MAS reciprocity.

Connections to Prior MAS Work. The paper situates pressure-field coordination within foundational MAS research:

- Unlike Horling & Lesser's organizational paradigms, pressure-field achieves role-free coordination through shared gradients.
- Unlike GPGP's explicit task structures and commitment protocols, pressure-field requires no inter-agent messages—$O(1)$ coordination overhead.
- Unlike SharedPlans and Joint Intentions, pressure-field eliminates intention reasoning; the shared artifact *is* the mutual belief.
- We compare directly against AutoGen-style conversation baselines, demonstrating 4× higher solve rates.
- We extend stigmergic principles to FM-based artifact refinement, showing how FMs overcome the action enumeration limitation.

Empirical Results. Across 1350 trials on meeting room scheduling: pressure-field achieves 30× higher solve rates than hierarchical control (48.5% vs 1.5%), 4× higher than conversation-based approaches (48.5% vs 11.1%), all comparisons highly significant ($p < 0.001$, Cohen's $h > 1.0$). On medium and hard problems, only pressure-field achieves non-zero solve rates. These results challenge the assumption that explicit coordination outperforms implicit coordination.

Theoretical Results. The paper provides convergence guarantees under pressure alignment (Theorem 1), $O(1)$ coordination overhead (Theorem 4), and proves temporal decay is necessary to escape local minima (Theorem 3).

This work has not been published in a peer-reviewed venue. An arXiv preprint of this manuscript exists (January 2026).

Sincerely,

Roland R. Rodriguez, Jr.