Summary Post

by Abdulrahman Alhashmi - Friday, 15 August 2025, 9:45 PM
Number of replies: 1

The increasing complexity of computational problems and the demand for autonomous, distributed solutions have driven the rise of agent-based systems (ABS). Unlike monolithic architectures, ABS consist of intelligent agents capable of perceiving their environment, making decisions, and interacting with other agents or systems. This decentralised approach offers flexibility, scalability, and adaptability, making it well suited to dynamic business environments (Wooldridge, 2021).

A key driver of ABS adoption is the shift from centralised control to modular, distributed architectures. Each agent can operate semi-independently while contributing to shared organisational goals. In domains such as logistics, supply chain management, and simulation modelling, ABS enable real-time coordination among multiple stakeholders, improving efficiency and responsiveness (Jennings, Sycara and Wooldridge, 1998; Macal and North, 2010).

A foundational model in ABS design is the Belief–Desire–Intention (BDI) framework, which mirrors human reasoning by aligning beliefs (perceptions of the environment), desires (objectives), and intentions (plans of action). This model supports context-aware, goal-driven behaviours that are critical in fast-changing environments (Dennis and Oren, 2022). Recent research highlights its practical applications—Rüb and Dunin-Kęplicz (2020) developed a BDI-based simulation for autonomous traffic systems, demonstrating how agents can maintain consistent, responsive behaviour in complex, multi-agent contexts. Similarly, Archibald et al. (2021) enhanced transparency in BDI agents, improving collaboration between humans and autonomous systems.

ABS are assisting businesses in every sector to mimic human and system interfaces, streamline the decision-making process, and handle uncertainty. Their adaptability motivated by AI facilitates operational agility as well as tactical foresight. With the increasing interconnectedness of systems, ABS ensure the synthesis of autonomous maneuvering and cooperative orchestration, providing local adaptability and global integration at the same time.

To summarize, ABS the combination of incorporated autonomous systems and intelligent coordination proves to have great potential in strategic advancement of computational design. They have the potential to adapt and be understood in high-demand, real-world situations, especially with frameworks such as BDI.

References

Archibald, B. et al. (2021) ‘Observable and Attention-Directing BDI Agents for Human-Autonomy Teaming’, Electronic Proceedings in Theoretical Computer Science, 348, pp. 167–175. https://doi.org/10.4204/EPTCS.348.12.

Dennis, L.A. and Oren, N. (2022) ‘Explaining BDI agent behaviour through dialogue’, Autonomous Agents and Multi-Agent Systems, 36(2), p. 29. https://doi.org/10.1007/s10458-022-09556-8.

Jennings, N.R., Sycara, K. and Wooldridge, M. (1998) ‘A roadmap of agent research and development’, Autonomous Agents and Multi-Agent Systems, 1(1), pp. 7–38. https://doi.org/10.1023/A:1010090405266.

Macal, C.M. and North, M.J. (2010) ‘Tutorial on agent-based modelling and simulation’, Journal of Simulation, 4(3), pp. 151–162. https://doi.org/10.1057/jos.2010.3.

Rüb, I. and Dunin-Kęplicz, B. (2020) ‘BASTA: BDI-based architecture of simulated traffic agents’, Journal of Information and Telecommunication, 4(4), pp. 440–460. https://doi.org/10.1080/24751839.2020.1755529.

Wooldridge, M. (2021) An introduction to multiagent systems. 2nd edn. Chichester: Wiley.