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Organizational dynamics in adaptive distributed search processes: effects on performance and the role of complexity

Key words: Agent-based simulation, Complexity, Coordination, Distributed search, NK landscapes

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Motivation/Main idea

- The main idea of this paper is to alter the organizational set-up of a search system in the course of search.
- It is well known that the complexity of a search problem considerably may affect the performance of a search system.
- Hence, an obvious idea is to analyze the effect of inducing organizational dynamics for different levels of complexity of a search problem.

Method

- Agent-based simulation based on the framework of NK fitness landscapes as introduced by Kauffman and Levin (1987) and Kauffman (1993)*.

- The simulation model captures two intertwined adaptive processes: in short term, search for solutions with superior levels of fitness and, in mid term, alteration of the organizational set-up of the short-term search.

- Simulations are conducted for various levels of complexity of the short-term search problem and for different temporal modes of mid-term alterations.

* Kauffman, S., Levin, S., 1987. Towards a general theory of adaptive walks on rugged landscapes. *J. Theor. Biol*., **128**(1):11-45.
Kauffman, S., 1993. The Origins of Order: Self-Organization and Selection in Evolution. Oxford, Oxford University Press.

Results: key findings

- Results indicate that altering the organizational set-up increases the effectiveness of search.

- This is found for all temporal modes of altering the organizational set-up studied: altering once, periodically and depending on whether, or not, a certain threshold of fitness enhancement has been achieved within a certain time.

- A main source for the performance enhancing effect is that organizational dynamics increases the diversity of search.

Results: complexity

- The performance enhancing effect of organizational dynamics varies with the complexity of the search problem.

- The fitness-driven mode of organizational dynamics is particularly prone to the level of complexity.

- Should the level of complexity itself be increased in the course of the search process, in most cases analyzed, though not universally, inducing organizational dynamics is beneficial.

Conclusions

- Increasing organizational dynamics has the potential to increase the effectiveness of adaptive distributed search processes.

- The beneficial effects of organizational dynamics considerably vary with the temporal mode of alterations and the complexity of the search problem.