# MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

## Self-organised adaptive biophysical networks


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Networks are common within biological systems and have been characterized in a range of different contexts that include metabolism, protein-protein interaction, neuronal circuits and ecological food webs. However, one area that has received little attention is analysis of organisms whose entire growth form is as a network. Unlike vascular transport systems in plants and animals, these networks are not constrained to a predictable structure, but explore space in the search for patchy and ephemeral nutrients, continuously adapting to varying external conditions, in the face of competition, damage and predation. In the laboratory, the same organisms can be set various problem-solving tasks that may help to provide a mechanistic basis for their unique morphology and dynamic resource allocation, but have also been interpreted as manifestations of emergent de-centralised problem-solving in non-neuronal organisms. Some aspects of their behaviour can be captured by simple mathematical models, based on a non-linear feed-forward term and a linear decay term, that echoes emergent behaviour in agent-based models of colonial insects, notably ant-colony optimisation algorithms, or even neuronal reinforcement. Furthermore, reaction-diffusion equations with similar terms are known to have rich pattern forming properties in free space, generating the well-known Turing patterns. This hints that solutions to a certain class of optimisation problems may be solved (approximately) by iteratively running reaction-diffusion equations within a network architecture, which is itself modified by the flows within it.


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**MPIDS, Prandtl lecture hall, building AI,**
**Am Faßberg 11, Göttingen**


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