Structural stability and evolution of biological networks

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The talk gives some ideas how biological networks may have evolved and have gained their apparent robustness.

More precisely we consider dynamical systems describing population dynamics on an interaction or "linkage" graph. This is an abstraction of a situation where ecological, biochemical species or genes interact in a spatially discrete (compartmental) or homogeneous environment (ecosystem, cell) with each other. An important idea will be how by mutation and selection events such networks can gain robustness, i.e. their property to retain a similar system behaviour with respect to different perturbations (changes in initial conditions, parameters and network structure). As this is a very general problem we will only be able to give some specific examples. As very often precise kinetic parameters of ecosystems or metabolic, signalling or genetic networks are rarely known, we also discuss the possibilities of so-called "stiochiometric" approaches in network theory (see for example [1]). Extensions to "weak" dynamical theories, like the implication of persistence of species from the network topology, will be given. We will discuss methods like in [4]. Finally, implications for research in ecology and cell biology are discussed, for example the problem of "upscaling" (like in [2]).

References

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