KERMIT

ENTROPY PRODUCTION AND ECOLOGICAL INTERACTION NETWORKS

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BACKGROUND

All

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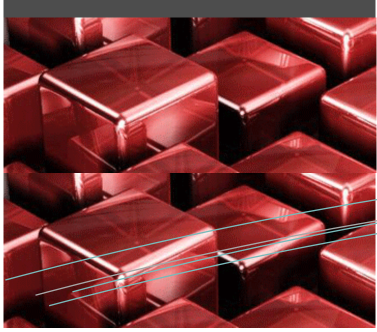

Background

While biology strives for an accurate, yet comprehensible description of all species on planet earth, ecology tries to tie these building blocks together in ecological interaction networks, e.g. food webs, as to understand how the interactions and relations between species result in a well-functioning ecosystem.

Assuming the existence of different species, and an ecological interaction network equipped with competitive, predatory and mutualistic interactions connecting those species, computational ecologists construct differential equations whose dynamics are analyzed in order to find out how species are able to coexist. While this approach has provided us with many insights, its strong assumptions restrict its usability when trying to answer more fundamental questions about ecosystems and life in general.

Taking a step back, we notice that ecosystems have to obey the laws of chemistry, which in turn obey the laws of physics. From this set of less stringent assumptions, the principle of maximum entropy production stands out as one that could explain why ecosystems are structured the way they are. The principle proposes that the sole purpose for the existence of ecosystems is the transformation of high-quality energy, reaching planet earth in the form of sunlight, into low-quality energy, in the form of heat, through the production of entropy. It is thought that ecosystems are structured as to execute this task as efficiently as possible.

Scope of the thesis

In this thesis, we learn how to construct ecological interaction networks, how to model their dynamics using differential equations, and how to calculate their entropy production. Once acquainted with these tools, we set out to construct ecological interaction networks that maximize entropy production, so that we can learn about their properties. Our findings are then put to the test by calculating the entropy production of ecological interaction networks for which experimental data is available in literature.