Master Thesis
Temporal networks for dynamical transitions

Complex network are all around us - the internet, traffic routing, and food webs are just some examples. In the context of mechanical engineering, networks can be used to describe the interplay of different machine components. Analyzing the nonlinear dynamics of a machine is an active field of research that poses many interesting challenges. In this work, we want to use network representations to track the interplay of components over time. How to specific machine components interact, and under which conditions? What happens during a dynamical transition, such as a bifurcation?
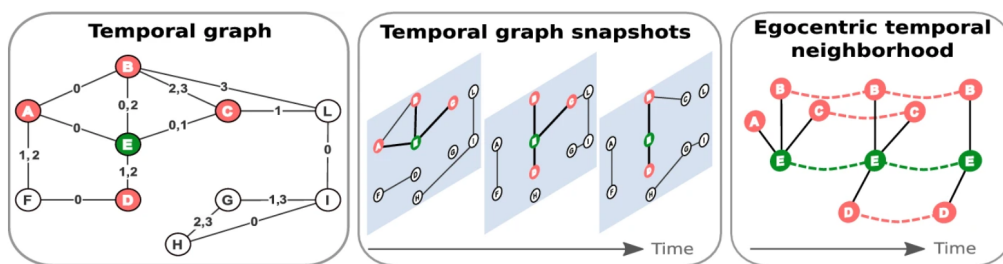

Figure 1: Several time-consecutive snapshots of a temporal graph put into relation using the egocentric temporal neighborhood method. Original figure from [1], available under a CC BY 4.0 license.

This project leverages previous work by Longa et al.[1], who introduced a method to analyze the time evolution of a network. The algorithm is based on the egocentric temporal neighborhood (ETN), and allows efficient comparison between the evolution of different dynamical systems.

Your tasks:

- familiarizing yourself with the ETN software

- application of ETN analysis to graphs from model systems with different dynamics, studying advantages and potential pitfalls

- thesis can be written in English or German

Your profile:

- no prior knowledge of networks or network methods necessary

- basic knowledge of structural dynamics and a programming language such as Python or Matlab helpful

- curiosity, an independent work style and open communication

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[1]Longa et al.: An efficient procedure for mining egocentric temporal motifs. Data Min Knowl Disc 36, 355–378 (2022), https://doi.org/10.1007/s10618-021-00803-2

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