Project topics for students (guided individual study, diploma, TDK)
Prof. Gábor Szederkényi

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1) Modelling and control of gene regulatory networks. We use probabilistic models of gene regulation and protein production. Recently, we have described the model in a form that is quite new in the literature, but which greatly facilitates dynamic analysis and control design. We are collaborating with the Valencian Institute for Systems Biology on this topic (https://www.uv.es/institute-integrative-systems-biology-i2sysbio/en/institute-integrative-systems-biology-i-sysbio.html)
further information: https://link.springer.com/article/10.1007/s11538-023-01251-3

2) Epidemic modeling and control. This topic was brought by COVID in 2020, and we have obtained very interesting results and now we can build on them. We are currently mainly concerned with how well controllers designed from simple models work with a realistic agent-based simulator, i.e. trying to make intervention design realistic.This work is carried out in the framework of a Hungarian national laboratory (Health Security).
further information: https://link.springer.com/article/10.1007/s11071-020-05980-1
https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1009693
https://www.mdpi.com/2076-3417/12/3/1113
https://ieeexplore.ieee.org/document/9852431

3) Bio-inspired modelling of traffic networks. This is a truly interdisciplinary work in collaboration with Chalmers University in Sweden (https://www.chalmers.se/en/departments/e2/). The basic idea is that with a few tricks, road traffic models can be mathematically described as certain biological/biochemical reaction networks. In this way, the methods of analysis and design can be significantly extended and the operation can be understood from an entirely new perspective.
further information: https://www.sciencedirect.com/science/article/pii/S0968090X23004254

4) Modelling drug absorption through the skin. We are working on this topic together with Prof. Franciska Erdő's group. They do the measurements and we model the absorption process. There are quite a lot of parameter estimation (model fitting) tasks and problems here. This work is exciting and challenging, because you have to get the 'best' model for a given purpose (e.g., state estimation or control) from relatively few measurement data.
further information:
https://www.dropbox.com/scl/fi/xij7uaxvynrph3m7kzy11/dermal_model_rev_final.pdf?rlkey=hsj3wkyfaqm21595xlnnu5o2y&dl=0