Simulation and data analytics of Cyber-Physical System

Cyber-physical systems, such as automobiles, cars, and medical devices, comprise both a physical part and a software part, whereby the physical part of the system sends information about itself to the software part, and the software sends information, usually in the form of commands, to the physical part. The inherent interconnected and heterogeneous combination makes the analysis of those systems a formidable problem in terms of both performance and safety of humans and the environment [1].

The course introduces simulation and data analytics in support of cyber-physical system development. Emphasis is put on practical applications, developed in C, C++, taken from the cybersecurity and automotive sectors. Open issues of Artificial Intelligence (AI) are touched as well (e.g., how to certify safety with AI?), in order to give hints into the recent trends of the sector.

References

[1] P. G. Larsen, J. Fitzgerald, J. Woodcock, and T. Lecomte. Trustworthy Cyber-Physical Systems Engineering, Chapter 8: Collaborative Modelling and Simulation for Cyber-Physical Systems. Chapman and Hall/CRC, September 2016. ISBN 9781498742450.

[2] ISO/IEC JTC 1/SC 42 Artificial Intelligence certification working group, https://jtc1info.org/jtc1-press-committee-info-about-jtc-1-sc-42/.

Lessons

1) Introduction to the latest trends of machine learning applications

2) Bayes decision theory (BDT) and estimation of unknown probability density functions

3) A practical example of covert channels in cyber security: C code for feature extraction, Matlab code of BDT

4) eXplainable AI (XAI): trends and algorithms

5) safety of platooning of vehicles: C++ code for simulation

6) Feature extraction and XAI for: collision prediction of platooning of vehicles*, cyber attacks in vehicular networks

7) Rulex: a real big data analytics platform, reliable AI: problem and trends of research**.

* https://github.com/mopamopa/Liapunov-Logic-Learning-Machine

** https://github.com/mopamopa/Platooning