Hybrid modeling approach to describe uncertain dynamic systems: what we are better than computer scientists

Joseph S. Kwon[†], Dongheon Lee, Mohammed Saad Faizan Bangi
Texas A&M University
(kwonx075@tamu.edu[†])

Bio-process is difficult to model given its use of living micro-organisms to produce useful products via complex mechanisms. These reactions and their kinetics are hard to characterize; hence, there approximate formulations are used when building a first-principled model. Consequently, such a model will be of poor accuracy. Recently, there is a lot of interest towards data-driven modeling as the amount of data collected, stored, and utilized is growing tremendously due to advent of supercomputing power and gigantic data storage systems. Additionally, data-driven models are simple and easy to build but their utility is hugely restricted by the amount and quality of data used to develop them. Therefore, hybrid modeling is an attractive alternative to purely data-based modeling, wherein it combines a first-principled model with a data-driven model resulting in improved accuracy and robustness. We have successfully validated the developed hybrid modeling approach with two cases case studies: NF-κB signaling pathways and a bio-fermentation reactor.