What is the Right Context for an Engineering Problem: Finding Such a Context is NP-Hard

Martine Ceberio[1], Vladik Kreinovich[2],
Hung T. Nguyen[2,3], Songsak Sriboonchitta[3],
and Rujira Ouncharoen[4]
[1]Department of Computer Science
University of Texas at El Paso
El Paso, Texas 79968, USA
mceberio@utep.edu, vladik@utep.edu
[2]Department of Mathematical Sciences
New Mexico State University
Las Cruces, New Mexico 88003, USA
hunguyen@nmsu.edu
[3]Faculty of Economics
[4]Department of Mathematics
Chiang Mai University, Thailand
songsakecon@gmail.com, rujira.o@cmu.ac.th

In the general case, most computational engineering problems are NP-hard. So, to make the problem feasible, it is important to restrict this problem. Ideally, we should use the most general context in which the problem is still feasible. In this paper, we start with a simple proof that finding such most general context is itself an NP-hard problem. Since it is not possible to find the appropriate context by utilizing a general algorithm, it is therefore necessary to be creative – i.e., in effect, to use computational intelligence techniques. On three examples, we show how such techniques can help us come up with the appropriate context. These examples explain why it is beneficial to take knowledge about causality into account when processing data, why sometimes long-term predictions are easier than short-term ones, and why often for small deviations, a straightforward application of a seemingly optimal control only makes the situation worse.