Model Order Reduction in Digital Twins: a Simulated Reality System

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ABSTRACT

Computer simulation in engineering, as we know it today, is the result of centuries of research and developments. It is necessary to go back, around the 17th to 19th centuries, to locate the classical theories on which much of current scientific advances are based. Until now, we know how progress in computer simulation has been developed, but the big question is where the trends are going in the near future. We cannot predict upcoming events, but we can estimate current demands, and bet that their satisfaction will mark future lines. Thus, users seek to have intuitive simulation tools to simulate any type of problem quickly and efficiently. We are used to immediate and barrier-free access to any type of information thanks to the connected world and the internet, so that ease of access is also what users look for in simulation tools. The real requirements that we think that simulation systems must meet in the coming years include the ability to compute any problem, which also involves large multiparametric solutions, with immediate response (real-time evaluations) and perceiving the results in an easy way.

Actual computer simulators have reached a point of maturity and development so advanced that few improvements can be made to their core. We believe that an important jump is necessary to meet the needs of the 21st century users. The digitalization is calling for the introduction of machine learning techniques together with classic solvers to manage those macroscopic solutions that users are asking for, a push that only data science can provide. It is not a question of leaving out the classical knowledge, instead, it is a reinforcement of all these theoretical concepts by means of artificial intelligence to generalize knowledge, creating a symbiosis that generates results that are hardly accessible without the mixture of classical methods and the most modern advances in machine learning.

To carry out all of the above, this work settles the foundations of simulated reality, understood as an evolution of the augmented reality systems where information of the physical behavior of objects is added. This information comes from simulation-based engineering science, so the physical interactions are described with a high degree of evidence. It mixes developments on numerical algorithms for solving partial derivative equations, model order reduction methods, data assimilation and measurement techniques using computer vision.

REFERENCES