IFAC World Congress 2020 Open Invited Track: Large-scale and infinite dimensional dynamical model approximation

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Abstract: The purpose of this Open Invited Track is to present theoretical and methodological advances in dynamical model approximation as well as an illustration how crucial the approximation phase is for solving a broad class of control and optimization-oriented engineering problems.

Keywords: Model approximation, Model reduction, Data-driven, Large-scale dynamical systems

1. INTRODUCTION

Dynamical models play an important role in many engineering fields, including simulation, analysis, optimization and control of complex systems and processes. This role is even emphasized when critical systems are under consideration, and for which a deep attention and understanding are needed. Among others, this attention may be motivated by industrial, economical, societal, security and strategical reasons. Indeed, for these cases, digital-based solutions involving dedicated computer-based software are being developed and largely preferred by engineers and researchers to reduce development costs and time, to improve and to better understand the systems under consideration. Nowadays, dynamical models clearly stand as a pivotal tool for engineers and researchers to enhance their knowledge and better optimize processes.

However, theses accurate models usually come with an increased complexity that may result in large-scale (or infinite) dynamical models, not well adapted to standard numerical tool (*e.g.* ODE solvers, control synthesis methods, ...), often resulting in problems when solving them, too computationally demanding and sensitive to rounding errors are the most common under them. Consequently, their approximation by an accurate low complexity dynamical model can be viewed as the cornerstone for further advanced developments, allowing bridging the gap between complexity and the control community (see *e.g.* Saad (2000); Antoulas (2005)).

2. OPEN INVITED TRACK DESCRIPTION

This Open Invited Track should address these points, namely, the (non)linear large-scale (and infinite dimensional) dynamical model approximation. Contributions can range from purely methodological as well as numerical advances to application in various control and industrial areas. The goal would be to show the wide application spectrum of this research field as well as the underlying methodological complexities of it.

Within these Open Invited Track we could therefore accommodate finite as well as infinite dynamical models, dynamical model approximation by input-output behaviour, by data-driven methods or others. More specifically one may (non exclusively) consider :

- Linear time invariant model approximation (*e.g.* linear, quadratic, bilinear, port-Hamiltonian...)
- Parametric linear time invariant model approximation
- Linear parameter varying model approximation
- Time-varying model approximation
- Non-linear model approximation
- Data-driven model approximation

Additionally, applications involving model approximation as a key step, might also be considered as relevant for this track. This may (non restrictively) include :

- Gain brought by the approximation for the control design
- Approximation for estimation, fault detection, ...
- Industrial application of model approximation (*e.g.* in fluid mechanics, network systems, ...)

REFERENCES

Antoulas, A.C. (2005). *Approximation of Large-Scale Dynamical Systems*. Advanced Design and Control, SIAM, Philadelphia.

Saad, Y. (2000). *Iterative Methods for Sparse Linear Systems*. SIAM, Philadelphia.