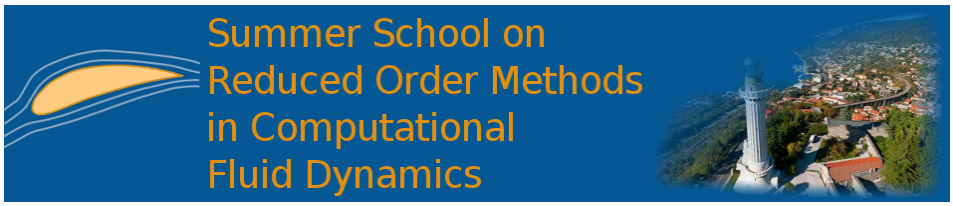

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Reduced Order Methods Applied to Nonlinear Time Dependent Optimal Flow Control Problems in Environmental Marine Sciences and Engineering

Wednesday, July 10, 2019 4:42 PM (3 minutes)

Optimal flow control problems governed by parametrized partial differential equations are a very powerful mathematical model. They are suitable to describe several complex physical phenomena and they are quite spread in different applications. Although, the computational effort increases when one has to deal with non-linear and/or time dependent governing equations [3,4,5].
We propose reduced order methods as an effective strategy to solve them in a fast and accurate way.
We applied our methodology in environmental marine sciences and engineering where parametrized optimal flow control is really useful to describe different parametric configurations which reliably reproduce physical phenomena. Since these adaptive simulations are very demanding and costly.
We exploit a POD-Galerkin reduction of the optimality system both for the linear and for the nonlinear case in order to save computational time. Two environmental applications are presented [3]: a pollutant control in the Gulf of Trieste, Italy and a solution tracking governed by nonlinear quasi-geostrophic equations describing nonlinear North Atlantic Ocean dynamic. Finally, we propose a parametrized reduced version of time dependent optimal control problems presented in [1,2]: we will show how reduce order methods are advantageous to this more complex context [4].

[1] M. Stoll and A. J. Wathen, "All-at-once solution of time-dependent PDE-constrained optimization problems", Technical Report, 2010.
[2] M. Stoll and A. J. Wathen, "All-at-once solution of time-dependent Stokes control", *J. Comput. Phys.*, **232(1)**, pp. 498 - 515, 2013.
[3] M. Strazzullo, F. Ballarin, R. Mosetti, and G. Rozza, "Model Reduction for Parametrized Optimal Control Problems in Environmental Marine Sciences and Engineering", *SIAM Journal on Scientific Computing*, **40(4)**, pp. B1055-B1079, 2018
[4] M. Strazzullo, F. Ballarin, and G. Rozza, "POD-Galerkin based Model Order Reduction for Parametrized Time Dependent Linear Quadratic Optimal Control Problems". *In preparation*,
[5] Z. Zainib, M. Strazzullo, F. Ballarin and G. Rozza, "Reduced order methods for parametrized nonlinear and time dependent optimal flow control problems: applications in biomedical and environmental marine sciences". *In preparation.*

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