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Optimal control and bifurcating systems: an application to Navier-Stokes equations

Maria Strazzullo[1], Federico Pichi[2], Francesco Ballarin[3] and Gianluigi Rozza[1]

[1] mathLab, Mathematics Area, SISSA, via Bonomea 265, I-34136 Trieste, Italy, mstrazzu@sissa.it, gianluigi.rozza@sissa.it

[2] Chair of Computational Mathematics and Simulation Science, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, federico.pichi@epfl.ch

[3] Department of Mathematics and Physics, Catholic University of the Sacred Heart, Brescia, Italy, francesco.ballarin@unicatt.it

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In this talk, we analyse the role of optimal control interacts in bifurcating solutions of nonlinear parametric partial differential equations [1]. Indeed, in the nonlinear setting, given a parameter, multiple solutions can arise from the same parametric value. The main question is: can optimal control change the behaviour and the stability of state solution branches when steering the solution towards a preferable desired profile?
We build a general framework for nonlinear optimal control problems to follow the optimal branches, investigating the stability properties of the obtained controlled solutions. The proposed strategy is applied to several test cases governed by bifurcating Navier-Stokes equations. We test the impact of the optimal control over a pitchfork bifurcation diagram in terms of behaviuor and stability eigenvalue analysis of the controlled state.
Moreover, we will briefly introduce model order reduction for such optimal control problems together with some numerical results in terms of reduction of the systems, since they can be exploited for faster analysis of these complex phenomena.

REFERENCES

[1] F. Pichi, M. Strazzullo, F. Ballarin and G. Rozza, Driving bifurcating parametrized nonlinear PDEs by optimal control strategies: application to Navier-Stokes equations with model order reduction, submitted, 2020.