

Close loop control of complex systems: low order linear model approach and nonlinear model free approach ¹

Thomas Duriez,² Institute PPRIME, Poitiers, France

Active turbulence control is a rapidly evolving, interdisciplinary field of research. In particular, closed-loop control with sensor information can offer distinct benefits over blind open-loop forcing. The range of current and future engineering applications of closed-loop turbulence control has truly epic proportions, including cars, trains, airplanes, jet noise, air conditioning, medical applications, wind turbines, combustors, and energy systems.

In a first part I will present how it is possible to look for linear behaviours in non-linear systems, and use this in order to control them. Investigating a free shear layer we devise a first order model single input/single output model. The feed-back control of the identified system requires fighting the time-delay due to convection from actuator to sensor. To this end we show how a Smith predictor can be effectively used in order to achieve feed-back tracking of turbulence level in the shear layer.

In a second part I will present a novel machine learning attractor control method which has proven itself remarkably effective for analytical nonlinear examples, numerical simulations and the TUCOROM mixing layer control demonstrator. This method is proposed as a generic model-free approach to control complex systems.

BIO:

Thomas DURIEZ works on closed-loop shear flow control in experiments and simulations. He is CNRS researcher at the ANR Chair of Excellence TUCOROM at Institute PPRIME and will be a CONICET (Argentina) researcher from March 2014. Past affiliation include LIMSI (Orsay), Laboratorio de Fluidodinamica (Buenos Aires), and PMMH/ESPCI (Paris, PhD). He co-authored much less publications than Bernd Noack and 1 patent. He has been awarded with the Jean Valembois award (Societe Hydrotechnique De France/EDF) in 2010.

¹The talk comprises joint work with Markus Abel, Marek Morzyński, Marc Segond, Tamir Shaqarin as well as Poitiers' TUCOROM Team (Bernd Noack, Jean-Paul Bonnet, Laurent Cordier, Joël Delville, Peter Jordan, Jean-Charles Laurentie, Vladimir Parezanovic and Andreas Spohn).

²<http://about.me/thomas.duriez>