

# Algebraic tools for the identifiability of Dinamical Systems

Prof. Maria Pia Saccomani<sup>1</sup>

<sup>1</sup> Dept. of Information Engineering  
University of Padova  
Email: pia@dei.unipd.it

**Timetable:** 16 hrs. Class meets every Monday and Wednesday from 10:30 to 12:30. First lecture on Wednesday, November 7, 2012. Room DEI/G (3-rd floor, Dept. of Information Engineering, Via Gradenigo 6/a).

**Examination and grading:** Homework and a final written examination.

**Aim:** The course is intended to illustrate the modern methods used to assess a priori identifiability of linear and especially nonlinear dynamical systems. In particular, the course is intended to provide a deep comprehension of the modern commutative algebra and differential algebra tools which can be applied to the study of a priori identifiability of dynamic systems described by polynomial or rational equations [1, 2, 3, 4]. Some hint will be given also to application of these mathematical tools to system and control theory problems. Emphasis will be given to systems describing biological phenomena [5].

## Course contents:

State space models of polynomial and rational dynamical systems. Global and local parameter identifiability. Basic concepts of commutative algebra. Gröbner bases and the Buchberger algorithm. Basic concepts of differential algebra. The Ritt algorithm. Software tool implementations. Case studies.

## References:

- [1] B. Buchberger. Grbner Bases and System Theory. In *Multidimensional Systems and Signal Processing*, Kluwer Academic Publishers, Boston (2001).
- [2] K. Forsman. *Constructive Commutative Algebra in Nonlinear Control Theory*, Linköping Studies in Science and Technology. Dissertation No. 261, Linköping University, Sweden (1991).
- [3] L. Ljung, and S.T. Glad. On global identifiability for arbitrary model parameterizations, *Automatica*, 30, 2, 265-276 (1994).
- [4] M.P. Saccomani, S. Audoly, and L. D'Angiò. Parameter identifiability of nonlinear systems: the role of initial conditions, *Automatica*, 39, 619-632 (2004).
- [5] M.P. Saccomani, S. Audoly, G. Bellu, and L. D'Angiò. Testing global identifiability of biological and biomedical models with the DAISY software, *Computers in Biology and Medicine*, 40, 402-407 (2010).