



# Symmetries and Semi-invariants in the Analysis of Nonlinear Systems

*Laura Menini, Antonio Tornambè*

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This book details the analysis of continuous- and discrete-time dynamical systems described by differential and difference equations respectively. Differential geometry provides the tools for this, such as first-integrals or orbital symmetries, together with normal forms of vector fields and of maps. A crucial point of the analysis is linearization by state immersion.

The theory is developed for general nonlinear systems and specialized for the class of Hamiltonian systems. By using the strong geometric structure of Hamiltonian systems, the results proposed are stated in a different, less complex and more easily comprehensible manner. They are applied to physically motivated systems, to demonstrate how much insight into known properties is gained using these techniques. Various control systems applications of the techniques are characterized including: computation of the flow of nonlinear systems; computation of semi-invariants; computation of Lyapunov functions for stability analysis and observer design.



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