Title: Perturbation Methods for Nonlinear Dynamical Systems

Aim: The short-course aims at introducing analytical asymptotic methods for solving weakly nonlinear problems for finite-dimensional dynamical systems. Particular attention is devoted to the Multiple Scale Method, which is able to automatically reduce the dynamics of the system to a manifold of the original space-state.

Duration: 6 hours divided into 3 lectures.

Arguments: Perturbation methods; dimension reduction; bifurcations; internal, external and parametric resonances.

Models: Algebraic nonlinear equations; weakly nonlinear ordinary differential equations; Duffing oscillator; Multi d.o.f. nonlinear mechanical systems.

Methods: Perturbation methods: straightforward expansion, strained coordinate method, Multiple Scale Method

Program:
Lecture 1 - quasi-linear algebraic equation; Eigenvalue and eigenvector sensitivity analysis; Multiparameter systems; Initial Value Problems: straightforward expansions
Lecture 2 - the Multiple Scale Method: basic aspects and advanced computational topics
Lecture 3 - Duffing oscillator under external excitations: primary, super-harmonic and sub-harmonic resonances; Duffing oscillator under parametric excitation; Multi-d.o.f. quasi-Hamiltonian systems under external/parametric/internal resonances

Bibliography: