ICIAM 2015

8th International Congress on Industrial and Applied Mathematics

PROGRAM & ABSTRACTS

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Bohun, C. Sean UOIT

Abstract: The rotating disk reaction vessel has a long standing use in the oil and gas industry to help characterize rock samples while drilling. One of the dominant chemical reactions in this sector is the carbonate system which is also seen in many systems in nature. By including the mathematics of this reaction with the dissolution mechanism, a way of understanding and possibly eliminating the the limitations of the rotating disk method is provided.

▶IM-Th-BC-60-2 10:30–11:00
Modelling and Optimizing A System for Testing Electronic Circuit Boards
Marcotte, Odile CRM & GERAD (HEC Montreal)

Abstract: We consider a difficult combinatorial optimization problem arising from the operation of a system for testing electronic circuit boards (ECB). Because of its diffculty, we first split the problem into a covering subproblem and a sequencing subproblem. We demonstrate that the solution of these two subproblems yields much better plans than those currently used. We conclude by giving a complete model of the test planning problem,

▶IM-Th-BC-60-3 11:00–11:30
Enhanced Training in the Mathematical Sciences: the GSMM Camp
Kramer, Peter Rensselaer Polytechnic Inst.

Abstract: The Graduate Student Mathematical Modeling (GSMM) Camp is an annual week-long meeting. At the Camp, graduate students work together in teams, with the guidance of faculty mentors, on interdisciplinary problems inspired by industrial applications. The program promotes a broad range of problem-solving skills, and provides the students with a valuable educational and career-enhancing experience outside of the traditional academic setting. The talk will focus on the organization, sample problems and outcomes of the Camp.

▶IM-Th-BC-60-4 11:30–12:00
The Year of Light in Industrial Mathematics: Case Studies from MPI
Moore, Richard New Jersey Inst. of Tech.

Abstract: The Mathematical Problems in Industry Workshop has for 30 years brought industrial researchers and academics in the mathematical sciences together for the purposes of highlighting the power of mathematical tools to elucidate technical problems and of demonstrating to faculty and graduate students the value of continued research in applied industrial mathematics. We introduce the MPI Workshop, and then present case studies focusing on the optics industry in recognition of the 2015 International Year of Light.

CP-Th-BC-61 10:00–12:00 101
Control, Dynamic systems
Chair: Kuzmina, Lyudmila Kazan Aviation Inst.-National Research Univ.
Abstract:

▶CP-Th-BC-61-1 10:00–10:20
Asymptotic Approach in Reduction/decomposition Problems for Multi-scale Systems Dynamics
Kuzmina, Lyudmila Kazan Aviation Inst.-National Research Univ.

Abstract: The paper is aimed to the different aspects of mathematical modelling and qualitative analysis in dynamics of complex multi-scale systems, that are generated by applied problems of engineering practice. Main goals are the problems of optimal mechanical-mathematical modelling and the regular schemes of decomposition in engineering design. The generalization of reduction principle, well-known in A.M.Lyapunov stability theory, is important goal for engineering practice. Uniform methodology, based on Lyapunov担methods, in accordance with Chetayev担stability postulate, is developed. The presented approach, with combination of stability theory and asymptotic methods, allows to elaborate the general conception of the modelling, to work out the regular schemes of engineering level for decomposition-reduction of full systems and dynamic properties. This approach enables to obtain the simplified models, presenting interest for applications, with rigorous substantiation of the acceptability. The conditions of qualitative equivalence between full model and reduced models are determined, with extended estimations of N.G.Chetayev担type on infinite time interval. In the applications to multi-scales engineering systems dynamics (for mechanical systems with big and small parameters gyroscopes, for electromechanical systems, for robotic systems,? the obtained results enable to decompose initial model and to construct the reduced models by strict mathematical way. The interpretation of these formalized constructions (reduced models) leads to new approximate theories, acceptable in applications of engineering practice. It allows to optimize the analysis process and synthesis, to cut down the engineering design time. As applications the different examples of concrete physical nature are considered.

The author is grateful to the Russian Foundation of Fundamental Investigations for support of research.

▶CP-Th-BC-61-2 10:20–10:40
Robust Control for A Class of Uncertain Dynamical Systems
Rathinasamy, Sakthivel Sri Ramakrishna Inst. of Tech.

Abstract: This paper addresses the problem of robust sampled-data H∞control for a class of uncertain dynamical systems (Mechanical systems) with uncertainty. By constructing a proper Lyapunov functional involving the lower and upper bounds of the delay, a new set of sufficient conditions are obtained in terms of linear matrix inequalities (LMIs) for the existence of H∞control law which ensures the robust stabilization of the uncertain dynamical systems about its equilibrium point for all norm bounded parameter uncertainties. Finally, a numerical example with simulation result is provided to illustrate the applicability and effectiveness of the proposed sampled-data control law.

▶CP-Th-BC-61-3 10:40–11:00
INTEGRABLE VARIABLE DISSIPATION DYNAMICAL SYSTEMS AND SOME APPLICATIONS
Shamolin, Maxim V. Lomonosov Moscow State Univ.

Abstract: This activity is a survey of integrable cases in dynamics of a lower- and multi-dimensional rigid body under the action of a nonconservative force field. We review both new results and results obtained earlier. Problems examined are described by dynamical systems with so-called variable dissipation with zero mean.
As exhibits we research dynamical equations of motion arising in studying the plane and spatial dynamics of a rigid body interacting with a medium and also a possible generalization of the obtained methods for studying to general systems arising in qualitative theory of ordinary differential equations, in theory of dynamical systems, and also in oscillation theory.

▶CP-Th-BC-61-4 11:00–11:20
On Certain Dynamic Inequalities and Its Applications on Time Scale
Pachpatte, Deepak Dr. Babasaheb Ambedkar Marathwada Univ.

Abstract: The main objective of the paper is to study explicit bounds of certain dynamic integral inequalities on time scales. Using these inequalities we prove the uniqueness of some partial intrgrodifferential equations on time scales.

▶CP-Th-BC-61-5 11:20–11:40
Bifurcational Geometric Methods for the Global Qualitative Analysis of Low-Dimensional Polynomial Dynamical Systems
Gaiko, Valery National Acad. of Sci. of Belarus

Abstract: The global qualitative analysis of low-dimensional polynomial dynamical systems is carried out. Using new bifurcational geometric methods, we solve Hilbert's Sixteenth Problem on limit cycles for the general 2D Liénard polynomial system with an arbitrary number of singular points. Applying these methods, we study also 3D polynomial systems and complete the strange attractor bifurcation scenario for the classical Lorenz system connecting globally the homoclinic, period-doubling, Andronov-Shilnikov, and period-halving bifurcations of its limit cycles.

▶CP-Th-BC-61-6 11:40–12:00
Numerical Null Controllability of Fractional Dynamical Systems
Govindaraj, Venkatesan Indian Inst. of Space Sci. & Tech.

Abstract: Many systems are better characterized using a non-integer order dynamic model based on fractional calculus. The fractional order integration and differentiation represent a rapidly growing field both in theory and in applications to real world problems. Controllability is one of the fundamental concepts in control theory which means that it is possible to steer a dynamical system from an arbitrary initial state to arbitrary final state using a set of admissible controls. Specifically this paper considers the problem of steering the state of a linear time invariant fractional dynamical systems to the origin when the control used is minimum energy admissible control. Sufficient conditions are given for the null controllability of nonlinear fractional dynamical systems. Moreover numerical aspects of the problem are discussed.

CP-Th-BC-62 10:00–12:00 102
Linear Algebra
Chair: Ratemi, Wajdi Univ. of Tripoli
Abstract:

▶CP-Th-BC-62-1 10:00–10:20
Tripoli Polynomials and Its Accompanying Differential Equations
Ratemi, Wajdi Univ. of Tripoli

Abstract: This paper introduces Tripoli polynomials that generate Waterloo