Abstracts for ICIAM 07

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Predictive differential equations. **Toru Ohira** (Sony CSL, Tokyo, Japan) IC/CT1875/015

We study a system whose dynamics are governed by predictions of its future states. In particular, the following type of equations are discussed,

$$\frac{\mathrm{d}x(t)}{\mathrm{d}t} = -\alpha x(t) + f(\bar{x}(\bar{t})), \quad \bar{x}(\bar{t} = t + \eta) = \eta \frac{\mathrm{d}x(t)}{\mathrm{d}t} + x(t),$$

with constants $\alpha > 0$, and a parameter $\eta > 0$, called *advance*. As shown here, we assume that the current rate of change of x continues for the duration of the advance to estimate the future state of x. This is a common prediction scheme for population projections, the national debt estimations and so on, and termed as *fixed rate prediction*.

We find that the increasing value of η, indicating how far ahead in time to make a prediction, can induce rather complex behaviors to otherwise simple dynamics with a stable fixed point when$\eta = 0$. This characteristics is similar to those found with delay differential equations with increasing delay. Hence, we discuss the comparison of this type of equations with delay differential equations, both of them are incorporating non-locality on the time axis.

We also report that an added noise can induce a behavior similar to *stochastic resonance* with a tuned combination of the noise strength and advance. We refer to this effect as *predictive stochastic resonance*.

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4D rigid body and some cases of integrability. **Maxim Shamolin** (Moscow State University, Russian Federation) IC/CT3863/033

A mathematical model is constructed describing the deceleration of a solid 2D-, 3D- and 4D-body moving in a medium with a jet flow around the body in fore-dimensional space. The regime of translational deceleration is shown to be normally unstable. This has made it possible to develop a relatively simple technique for determining model parameters experimentally. An example of the application of this technique to a cylindrical body is presented.

The deceleration problem turned out to be more convenient for checking the build-up effect by experiment. The present study made it possible to develop a fairly simple and efficient technique for determining the unknown parameters of the model. Statement of a problem about the motion of a rigid body in a resisting medium when all the conditions of jet or separated flow are satisfied is given. This interaction of a medium with a body is concentrated on that part surfaces of a body, which has the form of a flat 1D- (cut), 2D- (circle) and 3D-disk.

At formation of dynamic model of influence of a medium on a 2D-, 3D- and 4D-body some properties of a medium are marked and its have connected in a serie of hypothesises. And the basic hypothesis is a hypothesis of quasistationarity. In this connection complete dynamic system describing investigated model is shown. Such class of motions which allow some constrain is considered. That constrain is allowing to consider some quantity as a constant in all time of a motion. That quantity is size of velocity of some characteristic point of a rigid body. The qualitative analysis of dynamic system obtained in space of quasivelocities is presented and it is recognized all the non-linear non-trivial properties.

Effective matrix formalism for singularity analysis of differential equations and new intergrable system in nonlinear elasticity.
Lydia Novozhilova (Western Connecticut State University, USA), Sergei Urazhdin (West Virginia University, USA) IC/CT2702/030

New matrix formalism for finding series solutions to differential equations, developed by the authors earlier, and its extension to singularity analysis of ODEs and PDEs is presented.

Representing a power series as a product of two vectors

$$[a_0,\ a_1,\ a_2,\ \ldots] \cdot [1,\ x,/1!,\ x^2/2!,\ x^3/3!,\ldots]^T \qquad (1)$$

translates operations with analytic functions (like differentiation, multiplication by the independent variable, product of two such functions) into simple algebraic operations on the coefficient vectors and makes implementation of a classic power series method, even in the case of linear equations, elegant and simple. Using (1), a special matrix for computing the coefficient vector of the composite of two analytic functions can be defined, and information about the structure of this matrix can be pre-computed, stored, and used when needed. Using this universal matrix, nonlinear equations can be solved by