Mathematics at the Interface of Science and Technology - HeKKSaGOn Meeting 2019

Report of Contributions

https://indico.kit.edu/e/620

Contribution ID: **1** Type: **not specified**

Controllability and energy-optimal control of time-variant fractional systems

Thursday, September 12, 2019 4:40 PM (20 minutes)

Time-variant fractional models are used to describe many applications, e.g. lithium-ion batteries. For such models, neither a controllability criterion for state space equations nor the energy-optimal control function are available so far. To overcome this limitation, in this talk a reachability and controllability definition for time-variant fractional state space systems is formulated and the analytical solution of the energy-optimal control problem is presented.

Author: Dr NAGATOU, Kaori (Karlsruhe)

Presenter: Dr NAGATOU, Kaori (Karlsruhe)

Contribution ID: **2** Type: **not specified**

Family of Seiberg-Witten theory and topology of fiber bundles

Thursday, September 12, 2019 2:25 PM (20 minutes)

In this talk we will present an example of topological fiber bundles whose base, fiber and total manifolds are all smoothable, but they are not smoothable as fiber bundles.
As three basic tools, we use a family Seiberg-Witten theory developed by Baraglia-Konno, Kirby-Siebenmann theory and topological invariance of rational Pontryagin classes by Novikov.
This is a joint work with H.Konno and N.Nakamura.

Author: Prof. KATO, Tsuyoshi (Kyoto)

Presenter: Prof. KATO, Tsuyoshi (Kyoto)

Contribution ID: **3** Type: **not specified**

An Introduction to Central Limit Theorems for Fréchet Means on Manifolds

Thursday, September 12, 2019 2:55 PM (20 minutes)

Generalizing the concept of an expected value to metric spaces, Fréchet (1948) introduced means as minimizers of expected squared distance. Bhattacharya and Patrangenaru (2005) derived a central limit theorem (CLT) for such Fréchet means on manifolds under rather obscure conditions. We generalize their CLT and shed some light on these obscure conditions. It turns out that the CLT may have limiting rates different from the classical Euclidean $n^{-1/2}$. The challenge remains, however, to fully understand under which conditions, which specific CLT is valid. This, hopefully, gentle introduction is based on joint work with Benjamin Eltzner.

Author: Prof. HUCKEMANN, Stephan (Göttingen)

Presenter: Prof. HUCKEMANN, Stephan (Göttingen)

Contribution ID: **4** Type: **not specified**

(title unknown)

Thursday, September 12, 2019 3:50 PM (20 minutes)

Author: Dr SANDERS, Andrew (Heidelberg)

Presenter: Dr SANDERS, Andrew (Heidelberg)

Contribution ID: **5** Type: **not specified**

Curvature, Laplace operator, and distance between spaces

Thursday, September 12, 2019 4:15 PM (20 minutes)

In this talk we introduce a distance between two spaces, so-called Gromov-Hausdorff distance, and discuss a question how geometric/analytic quantities are close if the distance is small.

Author: Prof. HONDA, Shouhei (Tohoku)

Presenter: Prof. HONDA, Shouhei (Tohoku)

Contribution ID: **6** Type: **not specified**

Cut locus and Riemannian central limit theorems

Friday, September 13, 2019 9:00 AM (20 minutes)

Statistics on Riemannian manifolds has attracted much interest, it being the natural setting for considering data on smooth curved spaces. I will discuss a Central Limit Theorem for closed Riemannian manifolds, assuming certain stability hypothesis for the cut locus, which always holds when the manifold is compact but may not be satisfied in the non-compact case. This is joint work with Bejnamin Eltzner, Stephan Huckemann, and Wilderich Tuschmann.

Author: Dr GALAZ-GARCIA, Fernando (Karlsruhe)

Presenter: Dr GALAZ-GARCIA, Fernando (Karlsruhe)

Contribution ID: **7** Type: **not specified**

Geometrical characteristics study for cardiovascular problems

Friday, September 13, 2019 9:25 AM (20 minutes)

Aortic aneurysm and aortic dissections persist as life-threatening hazards. Although patient-specific simulations are common in biomedical engineering and extremely useful for a surgical planning etc., they remain insufficient to elucidate the general characteristics of targeted diseases. We introduce a geometrical characterization of blood vessels, which vary widely among individuals. Through close collaboration between mathematical science and clinical medicine, these analyses yield greater understanding leading to better risk assessments.

Author: Prof. SUITO, Hiroshi (Tohoku)

Presenter: Prof. SUITO, Hiroshi (Tohoku)

Contribution ID: **8** Type: **not specified**

Shape Optimization Problem based on Model-based and Data-Drive Approach

Friday, September 13, 2019 10:20 AM (20 minutes)

In this presentation, the author suggests shape optimization problem based on Model-based and Data-Drive Approach, for controlling transient flows effectively.

Author: Prof. NAKAZAWA, Takashi (Osaka)

Presenter: Prof. NAKAZAWA, Takashi (Osaka)

Contribution ID: **9** Type: **not specified**

Geometrical Smeariness

Friday, September 13, 2019 10:45 AM (20 minutes)

The central limit theorem (CLT) for the mean in Euclidean space features a normal limiting distribution and an asymptotic rate of $n^{-1/2}$ for all probability measures it applies to. We revisit the generalized CLT for the Fréchet mean on hyperspheres. For some probability measures,
the sample mean fluctuates around the population mean asymptotically at a scale $n^{-\alpha}$ with exponent $\alpha = 1/6$ with a non-normal distribution. This is at first glance in analogy to the situation on a circle. We show that the phenomenon on hyperspheres of higher dimension is qualitatively different, as it does not rely on topological, but
geometrical properties on the space, namely on the curvature, not on probability mass near the cut locus.

Author: Dr ELTZNER, Benjamin (Göttingen)

Presenter: Dr ELTZNER, Benjamin (Göttingen)

Contribution ID: **10** Type: **not specified**

The box-ball system with random initial conditions and Pitman's transformation

Friday, September 13, 2019 11:10 AM (20 minutes)

The box-ball system(BBS), introduced by Takahashi and Satsuma, is a cellular automaton that exhibits solitonic behaviour. We show that the BBS dynamics can be described by using the transformation of a nearest neighbour path encoding of the particle configuration given by 'reflection in the past maximum', which is known as Pitman's transformation. The techniques developed to understand the deterministic dynamics are subsequently applied to study the evolution of the BBS from a random initial configuration.

Author: Prof. TSUJIMOTO, Satoshi (Kyoto)

Presenter: Prof. TSUJIMOTO, Satoshi (Kyoto)

Contribution ID: **11** Type: **not specified**

Scalar curvature as moment map in generalized Kahler geometry

Thursday, September 12, 2019 3:20 PM (20 minutes)

Fujiki and Donaldson show that the moment map framework plays a crucial role in Kähler geometry and scalar curvature arises as the moment map for the action of Hamiltonian diffeomorphisms.
Generalized Kahler Geometry is a successful generalization of the ordinary Kahler Geometry.
In pursuit of this analogy, we show that there exists the moment map on a generalized Kähler manifold under the certain cohomological condition.
We prove that the Lie algebra of the reduced automorphisms is reductive if a generalized Kahler manifold admits a constant scalar curvature, which is an extension of Matsushima-Lichnerowiz theorem.

Author: Prof. GOTO, Ryushi (Osaka)

Presenter: Prof. GOTO, Ryushi (Osaka)

Contribution ID: **12** Type: **not specified**

Constructing mechanochemical patterns using geometric singular perturbation theory

Friday, September 13, 2019 9:50 AM (20 minutes)

Mechanochemical models present a new paradigm for biological pattern formation, where the interaction between domain curvature and pattern shape replaces the activator-inhibitor mechanism. Numerical simulations of a mechanochemical model formulated by M. Mercker & A. Marciniak-Czochra reveal a wide spectrum of novel patterning phenomena, which are as yet poorly understood from an analytical point of view. Our aim is to develop more analytical insight into the pattern formation process in mechanochemical models of this type. As a first step towards this goal, we show that one can employ methods from geometric singular perturbation theory to construct nonlinear, far-from-equilibrium patterns in a general class of mechanochemical models. This analysis reveals a direct relation between the biology –as encoded in the nonlinear interaction of model componens– and the type of (multiscale) patterns that can arise.

Presenter: Dr VEERMAN, Frits (Heidelberg)

Contribution ID: **13** Type: **not specified**

Joint Discussion about Future Projects and Cooperations

Friday, September 13, 2019 12:10 PM (45 minutes)

Contribution ID: **14** Type: **not specified**

Bridging the Gap - Medical Robots and Mathematics

Friday, September 13, 2019 11:40 AM (20 minutes)

Medical Robots are gaining interest in the field of healthcare due to their manifold advantages, such as enabling minimally-invasive surgical procedures with high precision, reduced tremor, and direct feedback from various sensors to the surgeon. In this talk, I will outline several medical robots, which are commercially available or focused on in current research. Additionally, I will stress the need for mathematical modelling as an applied field of mathematics bridging the gap to modern health care systems.

Author: Prof. MATHIS-ULLRICH, Franziska

Presenter: Prof. MATHIS-ULLRICH, Franziska