Adam Mickiewicz University
Faculty of Mathematics and Computer Science

GEOMETRY AND TOPOLOGY SEMINAR

13:45 AM, Tuesday, June 19, 2018
B1-37, Collegium Mathematicum

Speaker: Christian Lessig (Otto-von-Guerick-Universitat Magdeburg)

Title: Divergence Free Polar Wavelets

Abstract:

Divergence free vector fields play an important role in many systems in science and engineering, making their analysis and numerical representation important in fields ranging from climate science to medical imaging. We introduce a tight frame of divergence free wavelets that resolves the different scales and orientations that occur in these vector fields. Our wavelets are thereby divergence free in the ideal, analytic sense, have an intuitive correspondence to natural phenomena, closed form expressions in frequency and space, a multi-resolution structure, and fast transforms. Our construction also provides well defined directional selectivity that, among other things, models the behavior of solenoidal vector fields in the vicinity of boundaries. With suitable window functions, this provides (up to a logarithmic factor) an optimal approximation rate for piecewise continuous divergence-free vector fields in two dimensions. We demonstrate the numerical practicality and efficiency of our construction for the representation of solenoidal vector fields and the simulation of the Navier-Stokes equation.