Evolution Equations and Friends, 27 September 2019

Abstracts

Spyridoula Sklaveniti
Non-commutative discrete NLS-type hierarchy

Spyridon Dimoudis
Perturbations of Gibbs semigroups

In this talk we will concern ourselves with perturbations of the quantum harmonic oscillator. After a brief reminder of the basic properties of this operator, conditions for a perturbation to generate a semigroup will be presented and applied to square integrable complex potentials.

Jakub Stocek
Optimal operator preconditioning for pseudodifferential boundary problems

This work considers the Dirichlet problem for an elliptic pseudodifferential operator A in a bounded Lipschitz domain Ω, where Ω is either a subset of $\mathbb{R}^n$, or, more generally, in a Riemannian manifold Γ:

$$Au = f \text{ in } \Omega,\ u = 0 \ \text{ in } \Gamma \setminus \Omega\ .$$

We propose an operator preconditioner for general elliptic pseudodifferential equations of this kind. For linear systems of equations arising from low-order Galerkin discretizations, we prove that the condition number is independent of the mesh size and of the choice of bases for test and trial functions. The basic ingredient is a classical formula by Boggio for the fractional Laplacian, extended analytically. In the special case of the weakly and hypersingular operators on a line segment or a screen, our approach gives a unified, independent proof for a series of recent results by Hiptmair, Jerez-Hanckes, Nedelec and Urzua-Torres. Numerical examples illustrate the performance of the proposed preconditioner on quasi-uniform, graded and adaptively generated meshes. They show the increasing relevance of the regularity assumptions on themesh with the order of the operator.

Nikoletta Louca
Fractional Laplacians in polygonal domains

Solutions to pseudodifferential boundary problems in a polygonal domain exhibit singular behaviour at the boundary and corners. We discuss a unified approach to their regularity, based on techniques developed for elliptic differential equations with mixed boundary conditions. For the Dirichlet problem in a domain with smooth boundary, our approach recovers recent results of G. Grubb, as well as Ros-Oton and Serra, using independent methods. As an application, we obtain quasi-optimal convergence rates for Galerkin approximations on graded meshes. (Joint with Rafe Mazzeo, Heiko Gimperlein and Jakub Stocek.)

Thomas Hodgson
Finite volume methods for an interacting particle system

Many phenomena in biology can be thought of as a system of interacting particles. Of particular interest in these models is the emergence of coordinated motion and other complex behaviour. Here we look at a particle system of Vicsek-type and its associated continuum model. In the space-homogeneous case the dynamics can be described analytically, giving an ideal starting point from which to develop a numerical scheme. From there, we will discuss the next steps towards simulating the full system and briefly its relevance to insect motion. The work is based on the model of Buttà et al., and is supervised by Michela Ottobre and Kevin Painter.

Thamsanqa Castern Moyo
Incompressible fluids

A short review of Stochastic Navier-Stokes equations.