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Marianna Porfido (TU Bergakademie Freiberg)

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Aula A, Plesso di Matematica

Kernel estimates for parabolic systems of PDEs with unbounded coefficients

In this talk we consider a class of systems of nondegenerate elliptic partial differential equations with unbounded coefficients with possibly unbounded diffusion coefficients which may vary equation by equation. In particular, we deal with a vector-valued elliptic operator $\boldsymbol{\mathcal{A}}$ in divergence form defined on smooth functions $\boldsymbol{f}: \mathbb{R}^d \to \mathbb{R}^m$ by

$$(\boldsymbol{\mathcal{A}}\boldsymbol{f})_h = \operatorname{div}(Q^h \nabla f_h) + \langle b^h, \nabla f_h \rangle - (V\boldsymbol{f})_h$$
$$= \sum_{i,j=1}^{d} D_i(q_{ij}^h D_j f_h) + \sum_{i=1}^{d} b_i^h D_i f_h - \sum_{k=1}^{m} v_{hk} f_k$$

for $h = 1, \dots, m$, where $Q^h : \mathbb{R}^d \to \mathbb{R}^{d\times d}$, $b^h : \mathbb{R}^d \to \mathbb{R}^d$ for every $h = 1, \dots, m$ and $V : \mathbb{R}^d \to \mathbb{R}^{m\times m}$ are smooth enough functions. Under suitable assumptions, we prove pointwise upper bounds for the transition kernels of the semigroup associated in $C_b(\mathbb{R}^d; \mathbb{R}^m)$ with the operator $\boldsymbol{\mathcal{A}}$. The idea is to adapt and generalize to our setting the techniques exploited in the scalar case based on time-dependent Lyapunov functions for the parabolic operator $D_t + \boldsymbol{\mathcal{A}}$. We finally illustrate our results in case of polynomially and exponentially growing coefficients.

References

[1] D. Addona, L. Lorenzi, M. Porfido, *Kernel estimates for parabolic systems of partial differential equations with unbounded coefficients*, J. Math. Anal. Appl. **554** (2026), 130008.

Organizzatore: Davide Addona