DECAY OF LINEAR SEMIGROUPS AND APPLICATIONS TO PDEs

PoliMi Advisor: FILIPPO DELL'ORO, filippo.delloro@polimi.it

Co-Advisor: VITTORINO PATA, Politecnico di Milano, vittorino.pata@polimi.it

The theoretical study of evolutionary partial differential equations is a notable branch of the modern Mathematics, with an increasing number of challenging open problems that continuously attract the attention of several outstanding scholars. An effective and widely used approach in order to analyze the behaviour of the solutions consists in rephrasing the problem as an abstract first order ODE on an infinite-dimensional Banach space X. In the autonomous case, namely when the dependence on time is not explicit, the associated Cauchy problem takes the form

$$\begin{cases} u'(t) = Au(t), \\ u(0) = x_0 \in X, \end{cases}$$

where A is a certain operator acting on X, whose specific form is dictated by the equation under consideration. In the particular case when the operator A is linear, one can take advantage of the powerful theory of semigroups of bounded linear operators in order to investigate several remarkable questions, such as well-posedness and asymptotic stability of solutions. The first goal can be reached by showing that A is the infinitesimal generator of a $\mathcal{C}_0$-semigroup $S(t)$ on the phase space X. In this situation, the longterm dynamics of the underlying PDE can be analyzed by investigating the stability properties of the semigroup $S(t)$. The study requires a combination of several tools coming from different branches of Mathematical Analysis, such as complex analysis, functional analysis and operator theory.

The main goal of this doctoral thesis is the study of the decay properties of linear semigroups arising from partial differential equations of physical interest. Concrete examples include:

- Models of linear thermoelasticity and viscoelasticity (see e.g. [3, 4])
- Equations on time-dependent spaces (see e.g. [1])
- Abstract partially dissipative systems (see e.g. [2])

The research will be carried out at a high technical and theoretical level, exploiting recent and sophisticated techniques in the field and developing now ones in order to face the emerging challenges.

References

[1] M. Conti, V. Danese, C. Giorgi and V. Pata, A model of viscoelasticity with time-dependent memory kernels, *Amer. J. Math.* (to appear).

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[3] F. Dell'Oro, Asymptotic stability of thermoelastic systems of Bresse type, *J. Differential Equations* **258** (2015), 3902–3927.

[4] F. Dell'Oro and V. Pata, On the stability of Timoshenko systems with Gurtin-Pipkin thermal law, *J. Differential Equations* **257** (2014), 523–548.