## Minisymposium 15 - Operatortheorie

### Location of the spectrum of operator matrices which are associated to second order equations

CARSTEN TRUNK (TECHNISCHE UNIVERSITÄT BERLIN)

We study second order equations of the form

(1) $$\ddot{z}(t) + A_o z(t) + D\dot{z}(t) = 0.$$

Here the stiffness operator $A_o$ is a possibly unbounded positive operator on a Hilbert space $H$, which is assumed to be boundedly invertible, and $D$, the damping operator, is an unbounded operator, such that $A_o^{-1/2} D A_o^{-1/2}$ is a bounded non negative operator on $H$. This second order equation is equivalent to the standard first-order equation $\dot{x}(t) = Ax(t)$, where $A : \mathcal{D}(A) \subset \mathcal{D}(A_o^{1/2}) \times H \to \mathcal{D}(A_o^{1/2}) \times H$, is given by

$$A = \begin{bmatrix} 0 & I \\ -A_o & -D \end{bmatrix},$$

$$\mathcal{D}(A) = \left\{ \left[\begin{smallmatrix} z \\ w \end{smallmatrix}\right] \in \mathcal{D}(A_o^{1/2}) \times \mathcal{D}(A_o^{1/2}) \mid A_o z + Dw \in H \right\}.$$

This block operator matrix has been studied in the literature for more than 20 years.

It is well-known that $A$ generates a $C_0$-semigroup of contraction, and thus the spectrum of $A$ is located in the closed left half plane.

We are interested in a more detailed study of the location of the spectrum of $A$ in the left half plane. In general the (essential) spectrum of $A$ can be quite arbitrary in the closed left half plane. Under various conditions on the damping operator $D$ we describe the location of the spectrum and the essential spectrum of $A$.

The talk is based on joint work with Birgit Jacob (Delft).