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Domain invariance for nonlinear diffusion models

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In the paper
[An optimal partition problem for eigenvalues, Journal of scientific Computing 31 (2007), 1-2, pp. 5–18],
Caffarelli and Lin constructed a bilinear control that keeps the norm of the linear heat flow on a bounded domain
constant in time. The construction consists of taking a suitable nonlocal feedback: this problem has therefore clear connections with domain invariance for nonlinear diffusion equations with nonlocal terms.

In this talk, we will discuss abstract evolution equations in Hilbert and Banach spaces, for which we will give necessary and sufficient conditions for the invariance of a space domain. Then, we will apply these results to concrete PDE models that generalize the one studied by Caffarelli and Lin. In particular, we will show how the addition of nonlocal terms, allows to force the flow of nonlinear heat equations and the Navier-Stokes system to remain in specific space domains such as a sphere or a hyperplane in the configuration space.

Author: CANNARSA, Piermarco (Rome, Italy)

Orateur: CANNARSA, Piermarco (Rome, Italy)