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SOME PROPERTIES OF SOLUTIONS TO NONLINEAR PDE/ODES WITH STATE-DEPENDENT DELAY

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One of our goals is to propose and investigate a general class of non-linear partial differential equations with general type of time delays. The focus is on the *state-dependent* type of delays since the type is the most relevant to real-world applications. Particularly, we are interested in reaction-diffusion equations/ systems (in bounded domains) with delays in reaction terms.

We investigate the well-posedness in the sense of Hadamard as well as long time asymptotic behaviour of different types of solutions. The Lyapunov stability and the existence of global attractors are of prime interest.

Based on recent results from the qualitative theory of ODEs with state-dependent delays (SSD) we develop two independent approaches to well-posedness of PDEs with SDDs. The first approach uses restrictions to more regular initial functions (at least Lipschitz in time). On this way we discuss different phase spaces which are nonlinear sets.

The second approach [1] uses an additional condition on the (discrete) state-dependent delay functional (the so-called 'ignoring condition') which, in contrast to the first approach, allows to work in the *linear* classical phase space of continuous in time initial functions.

A recent study is connected to viral in-host infection models with SDDs [2]. We start with ODE formulations with constant delay, develop ODE models with SDDs (one of possible formulations is discussed in [2]) and arrive to a wide class of PDE models with SDDs. To the best of our knowledge such models have not been considered before. An interesting subclass of considered models is described by nonlinear hybrid PDE/ODEs systems with SDDs. The last means that diffusion terms allowed, but not required in each state equation. The hybrid nature of the system is motivated by the biological background of the model under consideration. The study is done in the framework of the project 16-06678S.

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