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A NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATION WITH AN UNBOUNDED KERNEL

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ABSTRACT. We prove well-posedness of a neutral functional differential equation

$$\frac{d}{dt}\int_{-\infty}^{0} g(s)u(t+s)\,ds = 0,$$

where g is close to a monotone increasing function h with $h(0) = \infty$. We utilize a history space semigroup setting in an L^2-space weighted by $e^{-\omega s}h(s)$. The problem considered here is motivated by a class of singular neutral functional differential equations arising in aeroelastic modeling.

1. Introduction. Singular integro-differential equations of neutral type (SNFDEs) have been proposed as input-output models to study certain fluid-structure interaction problems in aeroelasticity (see, e.g., [**1, 7**] and the references therein). To justify the applicability of these equations for control design purposes (e.g., active flutter suppression in airfoils) it is necessary to develop a state space theory for SNFDEs. For the sake of completeness we mention two characteristics (in terms of the kernel function g) of the SNFDE appearing in the aeroelastic control application: i) g is locally integrable but $g \notin \mathbf{L}^1(-\infty, 0)$; ii) g has a singularity at 0, but the neutral equation is nonatomic. As the consequence of properties i) and ii) we have to consider state-spaces for equations with infinite delay and with nonatomic difference operator. Furthermore, keeping control applications in mind, it is desirable to have Hilbert-space structure for the state-space. In order to accommodate a fairly large class of equations we also try to keep smoothness assumptions on the kernel g as weak as possible.

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