Operator DAEs with Noise Appearing in Fluid Dynamics

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We consider operator DAEs (or constrained PDEs) as they appear in applications from fluid dynamics. Thus, the constraint is given by the divergence operator and the system has the form

$$\begin{aligned} \dot{u}(t) + \mathcal{K}u(t) + \mathcal{B}^*\lambda(t) &= \mathcal{F}(t), \\ \mathcal{B}u(t) &= \mathcal{G}(t) \end{aligned}$$

with (consistent) initial condition $u(0) = u_0$. In applications such as the Stokes equations, u would be the velocity of the fluid and p would denote the pressure.
In this talk, we consider additional Gaussian white noise in the right-hand sides. Because of the differential-algebraic structure, noise terms may result in instabilities such that a regularization is necessary. We present such a regularization and show the resulting advantages.