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Existence of martingale solutions to a pseudomonotone evolution equation with multiplicative noise

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SUMMARY

Let $(\Omega, \mathcal{F}, \mathbb{P})$ be a classical Wiener space endowed with a filtration $(\mathcal{F}_t)_{t\in[0,T]}$, $T > 0$ with the usual assumptions, $D \subset \mathbb{R}^d$ be a bounded Lipschitz domain, $Q := (0,T) \times D$ and $p > 2$. Our aim is the study of the problem

$$(P) \begin{cases} du - \operatorname{div}(|\nabla u|^{p-2}\nabla u + F(u))\, dt = H(u)\, dW & \text{in } \Omega \times (0,T) \times D \\ u = 0 & \text{on } \Omega \times (0,T) \times \partial D \\ u(0,\cdot) = u_0 & \text{in } \Omega \times D \end{cases}$$

for a cylindrical Wiener process in $L^2(D)$ and $F : \mathbb{R} \to \mathbb{R}^d$ Lipschitz continuous. We consider the case of multiplicative noise with $H : L^2(D) \to HS(L^2(D))$, $HS(L^2(D))$ being the space of Hilbert-Schmidt operators, satisfying appriopriate regularity conditions. By an implicit time discretization of (P), we obtain approximate solutions. Using the theorems of Skorokhod and Prokhorov, we are able to pass to the limit and show existence of martingale solutions.

Keywords: pseudomonotone problem, stochastic forcing, cylindrical Wiener process, martingale solution

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