Stability of a general linear mechanical system with a white noise in parameters

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This is joint work with Peter Caithamer.

We discuss the behavior, for large values of time, of a linear mechanical system with a white noise in its parameters. The initial data may be random as well but are independent of white noise. It is well known that a free linear non-stochastic mechanical system with viscous damping is stable, i.e., its energy approaches zero as time increases. We calculate the expected energy and check that this behavior takes place for the stochastic system under consideration in the case when the initial data are random but the parameters are not. When the parameters contain a random noise the expected energy may be infinite, approach zero, remain bounded, or increase with no bound. This regime is similar to but more interesting than the known regime for the solutions of differential equations with time dependent periodic coefficients that describes the behavior of a mechanical system with characteristics which are periodic functions of time. We give necessary and sufficient conditions for stability in terms of the structure of roots of an auxiliary equation. We also present results of numerical simulations that confirm our results on stability. We explain why our approach may not be applied to some other models.