

This thesis covers the basics in the stochastic homogenization of elliptic partial differential equations, from underlying theory up to numerical approaches. In particular, we introduce and analyze a combination of the Fourier-Galerkin method in the spatial domain with a collocation method in the stochastic domain. The material coefficients are assumed to depend on a finite number of random variables. We present a comparison of the Monte Carlo method with the full tensor grid and sparse grid collocation method for two applications. The first one is the checkerboard problem with continuous random variables, the other considers the material coefficients to be described in terms of an autocorrelation function.