Numerical Solution of the Poisson Equation on Domains with a Thin Layer of Random Thickness

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SUMMARY

I will talk about the numerical solution of the Poisson equation on domains with a thin layer of different conductivity and of random thickness. By changing the boundary condition, the boundary value problem given on a random domain is transformed into a boundary value problem on a fixed domain. The randomness is then contained in the coefficients of the new boundary condition. This thin coating can be expressed by a random Robin boundary condition which yields a third order accurate solution in the scale parameter $\epsilon$ of the layers thickness. With the help of the KarhunenLoeve expansion, we transform this random boundary value problem into a deterministic parametric one with a possibly high-dimensional parameter $y$. Based on the decay of the random fluctuations of the layers thickness, we prove rates of decay of the derivatives of the random solution with respect to this parameter $y$ which are robust in the scale parameter $\epsilon$. Numerical results validate our theoretical findings.

Keywords: Poisson Equation, Numerical Solution

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