"Strange terms coming from nowhere"
Periodic and stochastic homogenization in perforated domains

Graduate seminar on Analysis (S4B2), Summer Term 2018

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Main references (as introduced in the preliminary meeting)*

1. D. Cioranescu and F. Murat, *A strange term coming from nowhere.* (Taken)
   (First paper to be presented. Periodic homogenization for Poisson equation)
2. G. Allaire, *Homogenization of the Navier-Stokes equations in open sets perforated with tiny holes. I-II.* (2 talks, 1 taken)
   (Periodic homogenization for Stokes and Navier-Stokes. Brinkmann and Darcy's law regimes)
3. G. C. Papanicolaou and S. R. S. Varadhan, *Diffusion in regions with many small holes.* (Taken)
   (Homogenization in perforated domains interpreted as motion among random obstacles)
4. A. Yu. Beliaev and S. M. Kozlov, *Darcy equation for random porous media.* (Taken)
   (Random homogenization for Poisson and Stokes equations. Darcy's law)
5. L. A. Caffarelli and A. Mellet, *Random homogenization of an obstacle problem.* (2 talks, 1 taken)
   (Homogenization treated as an obstacle problem. Holes with random shapes but periodic centres)

Additional material (organised by topic/area)*

I) **...more on punctured domains in other settings/ different equations**
- L. Desvillettes, F. Golse and V. Ricci, *The Mean-Field limit for solid particles in a Navier-Stokes flow.* (Taken)
  (A dynamical version of Allaire's paper. The particles move into the fluid)
- V. A. Marchenko and E. Y. Khruslov, *Homogenization of partial differential equations*, Chapter 2.(Taken)
  (Periodic and random homogenization for Poisson equation with correlated measures for the holes. Methods differ from [1]-[5])

II) **...more on the probabilistic approach**
- A.S. Snitzman, *Brownian motion, obstacles and random media*, Introduction and Chapter 7, Chapter 4.
  (More on random walks among random obstacles. Requires probabilistic background.)
- M.T Barlow and J.-D. Deuschel, *Invariance principle for the random conductance model with unbounded conductances.*(Taken)
  (Probabilistic interpretation for the homogenization of $-\nabla\cdot a\nabla$: Random walks in random environments. Interesting feature: Matrix $a \notin L^\infty$.)

III) **Application to material science**
- G. W. Milton and K. Solna, *Can mixing materials make electromagnetic signals travel faster?* (Taken)
  (Homogenization for composite materials giving rise to unusual effective properties. Applied paper)

IV) **Periodic/random homogenization for elliptic operators in divergence form**
- A. Bensoussan, J.L. Lions and G.C. Papanicolaou, *Asymptotic Analysis of Periodic Structure* (Ch.11, taken).
  (Periodic homogenization for the operator $-\nabla\cdot a\nabla$. If someone is interested, we can discuss about the chapter to be selected)
- G.C. Papanicolaou and S.R.S. Varadhan, *Boundary value problems with rapidly oscillating random coefficients*,
  S. M. Kozlov, *Averaging of differential operators with almost periodic rapidly oscillating coefficients.*
  (Random homogenization for the operator $-\nabla\cdot a\nabla$)

*: In case of problems in finding the exact references, please contact us.