Homogenization of compressible fluids in porous media

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In homogenization of compressible Navier–Stokes equations, an inverse of the divergence operator is crucial to obtain *a priori* bounds for the velocity and density independent of the perforation. Such inverse operators and bounds are well known in the case of periodically arranged holes with fixed diameter, where the mutual distance is of order $\varepsilon > 0$ and the radii scale like ε^α for some $\alpha > 3$. We generalize these results to the case of randomly distributed holes with random radii and give applications to the homogenization of the Navier–Stokes(–Fourier) equations in such randomly perforated domains. Furthermore, we investigate the case of critically sized holes $\alpha = 3$ in a periodically perforated domain. We show that under the additional assumption of a vanishing Mach number, the limiting equations are given by the incompressible Navier–Stokes–Brinkman system containing a "strange term" purely reminiscent from the holes. This is joint work with Peter Bella (TU Dortmund).