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How gradients in porosity can make a better filter IAN GRIFFITHS, MARIA BRUNA, MOHIT DALWADI, University of Oxford — Depth filters are a common device for removing contaminants from fluid. Porosity-graded filters, whose porosities decrease with depth, have been shown experimentally to offer improved filtration efficiency over filters with uniform porosity, by allowing contaminants to be trapped more evenly within the filter media. However, experiments are unable to probe the microscopic behavior, and so the underlying mechanisms that are responsible for this improved filtration are unclear. We use homogenization theory to derive a macroscopic model for the fluid flow and particle trapping within a porosity-graded depth filter. We find that gradients in porosity induce a macroscale particle advection in the direction of reducing porosity and show how particle trapping is more evenly spread through the filter for a decreasing porosity compared with a uniform porosity. By quantifying the removal rate, we show how a given operating regime can be fine-tuned to improve filter efficiency. The talk is accompanied by an online demonstration of MEMFI, a software package in which audience members may explore for themselves the effect of porosity gradients in user-specified operating regimes.

Ian Griffiths
University of Oxford

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