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Optimising the flow through a concertinaed filtration membrane[1]

VICTORIA PEREIRA, MOHIT DALWADI, IAN GRIFFITHS, University of Oxford — Membrane filtration is a vital industrial process, with applications including air purification and blood filtration. Recently, new techniques in the manufacturing process have been developed which enable the production of specific pore structures. Since this type of membrane can be precisely manufactured, it is important to understand how the flux through such filters can be optimised through design choice. We develop a model for the flow through a concertinaed filtration membrane composed of angled porous membranes and dead-ends, motivated by the direct-flow device designed by Smart Separations Ltd. We determine how the geometric and operating parameters affect the flow through the device, with the aim of determining the optimal setup to maximise the flux for a given pressure drop. We present results for a membrane of fixed angle and physical properties, and find that there can exist multiple membrane positions that maximise the flux. We also present more general results for membranes of arbitrary thickness and permeance. We show that while the maximal flux achievable depends on the membrane thickness and permeance, the optimal membrane configuration is always in one of two canonical setups, as determined by the trade-off in the underlying physics of the problem.

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