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A porous media model of transport in the brain interstitium[1]
SAIKAT MUKHERJEE, JEFFREY TITHOF, University of Minnesota — Material transport in the interstitial spaces of the mammalian brain is important for neuromodulation and clearance of waste products such as amyloid β, which is linked to Alzheimer's disease. However, the exact nature of the transport mechanism remains unclear. We use high-order numerical simulations to quantify advective and diffusive transport in the brain interstitium. To this end, we use a porous media model to understand the volume-averaged fluid flow between the perivascular spaces of the penetrating arterioles and venules in the brain interstitium. We solve the governing equations of fluid flow in a porous media along with a coupled advection-diffusion equation using experimentally observed parameters. We then quantify the relative importance of advective and diffusive transport in the brain interstitium, highlighting the differences between these two distinct transport mechanisms. Our numerical approach is quite general and it would be straightforward in the future to explore the coupled dynamics of advection-diffusion transport and spreading depolarization in the brain which is associated with events such as stroke, migraine and traumatic brain injury.

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