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## A One-domain approach for flow near porous media boundaries

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Momentum transport near porous media boundaries has been the subject of intense work for more than half a century since the pioneering work of Beavers and Joseph in 1967 [1,2]. Currently, there are two modeling strategies to study this subject: 1) A one-domain approach (ODA), where the spatial variations of average properties are accounted for in the transition zone and 2) a two-domain approach (TDA), where these variations are collapsed in a boundary condition [3]. The TDA has received much more attention than the ODA due to the practical use of jump conditions, whereas a closed-form of the ODA has been typically made obscure and dependent of pore-scale solutions in the entire system. Nevertheless, the derivation of a jump condition for the TDA requires that the ODA be developed first. In this work, a practical formulation of the ODA is presented, that is valid for a porous medium sharing boundaries with a free fluid [4], another porous medium or a solid material. It has the simple structure of a Darcy-like model involving a position-dependent permeability tensor that is predicted from the solution of an ancillary closure problem. The performance of the model is exemplified in the vicinity of a fluid channel, near the boundary of two porous media (either in direct contact or separated by a fracture) and for flow between a porous medium and an impervious wall [5]. In all cases, the model predictions are validated with pore-scale simulations showing an excellent agreement. Furthermore, in the case of a fluid-porous medium boundary, the model is also validated with experimental data [4]. The simplicity and versatility of the new ODA model provided here make it an interesting alternative to existing approaches in the literature.

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