Contribution ID: **316** Type: **Oral Presentation**

A One-domain approach for flow near porous media boundaries

Thursday, 2 June 2022 11:50 (15 minutes)

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 is 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.

References

[1] G. Beavers and D. Joseph, Boundary conditions at a naturally permeable wall,J. Fluid Mech. 30, 197 (1967).
[2] D. A. Nield, The Beavers–Joseph boundary condition and related matters: A historical and critical note, Transp. Porous Media 78, 537–540 (2009).
[3] M. Chandesris and D. Jamet, Boundary conditions at a planar fluid–porous interface for a Poiseuille flow, Int. J. Heat Mass Transfer 49, 2137–2150 (2006).
[4] F. J. Valdés-Parada and D. Lasseux, A novel one-domain approach for modeling flow in a fluid-porous system including inertia and slip effects, Phys. Fluids 33, 022106 (2021).
[5] F. J. Valdés-Parada and D. Lasseux, Flow near porous media boundaries including inertia and slip: A one-domain approach, Phys. Fluids 33, 073612 (2021).

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

France

References

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

Primary authors: Prof. VALDÉS-PARADA, Francisco J. (Universidad Autónoma Metropolitana-Iztapalapa); Dr LASSEUX, Didier (CNRS - Univ. Bordeaux)

Presenter: Dr LASSEUX, Didier (CNRS - Univ. Bordeaux)

Session Classification: MS07

Track Classification: (MS07) Mathematical and numerical methods for multi-scale multi-physics, nonlinear coupled processes