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Droplet formation, growth and detachment on the interface of a coupled free flow –porous medium system

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Interaction between free flow and porous medium is of great importance in various applications which is controlled by the interface between two domains. Since emerging a droplet on the interface significantly alters interface properties, it consequently has a considerable influence on coupling condition between free flow and porous medium. An interface including droplet not only handles exchange between free flow and porous medium, but also stores mass and energy [1]. Such an interface should also be able to describe the droplet behavior for instance formation, growth and detachment.
In order to better approximate the surface driven processes at the interface between the porous and the free flow, we use a pore network model [2, 3]. Here, the respective droplets are discretely approximated. Thus, the main processes such as the growth of the droplets and the detachment can be captured. Droplet detachment is captured by calculating the free flow forces on the droplet surface and the retention force, which results from the change in the contact angle of the droplet along its contact line with the solid surface and the interfacial tension between two immiscible fluids. Selected examples are used to discuss the interaction behavior between free flow, porous medium and the formation and detachment of droplets.

Time Block Preference

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

References

[1] Ackermann, S., Bringedal, C., & Helmig, R. (2020). Multi-scale three-domain approach for coupling free flow and flow in porous media including droplet-related interface processes. Journal of Computational Physics, 109993.
[2] Weishaupt, K., Terzis, A., Zarikos, I., Yang, G., Flemisch, B., de Winter, D. A. M., & Helmig, R. (2020). A Hybrid-Dimensional Coupled Pore-Network/Free-Flow Model Including Pore-Scale Slip and Its Application to a Micromodel Experiment. Transport in Porous Media, 135(1), 243–270.
[3] Weishaupt, K., Joekar-Niasar, V., & Helmig, R. (2019). An efficient coupling of free flow and porous media flow using the pore-network modeling approach. Journal of Computational Physics: X, 1, 100011.

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