11.03.2014 16:30	David Uribe	H9 Erwin-Rommel-Straße 60, Room 00.227

Determining the limits of geometrical tortuosity in porous media from pore-scale flow simulations

David Uribe (Ruhr-Universität Bochum), Maria Osorno (Universidad EAFIT), Rakulan Sivanesapillai (Ruhr-Universität Bochum), Holger Steeb (Ruhr-Universität Bochum), Oscar Ruiz (Universidad EAFIT)

Recent discoveries have found a strong dependency of effective properties (Θ_i) of a porous medium with the Reynolds number (Re) of a flow through the medium. The dependency strongly resembles a sigmoid function ($\Theta_i = S(Re)$). One of these properties is tortuosity. At very low Re (seepage flow), there is a characteristic value of the tortuosity, which is the upper horizontal asymptote of the sigmoid function. With higher values of Re (transient flow) the tortuosity value decreases, until a lower asymptote is reached (turbulent flow).

The current state of the art presents different numerical measurements of tortuosity, such as skeletization, centroid binding, and arc length of streamlines. These are solutions for the low Re regime. So far, for high Re, only the arc length of streamlines has been used to calculate the tortuosity value. This approach involves the simulation of fluid flow in large domains and high Re, which requires numerous resources, and often presents convergence problems. In response to these shortcomings, we propose a geometrical method to estimate the limit of tortuosity of porous media at $Re \to \infty$, from the streamlines calculated at low Re limit. Our method mainly consists on minimizing the arc length of the low Re streamlines with two methods. We test our method calculating the tortuosity limits in a fibrous porous media, and comparing the estimated values with benchmark results. Ongoing work includes the geometric estimation of other intrinsic properties of porous media.