Application of selected meshless method for analysis of flows in wavy conduits
Abstract

Flows through wavy conduits exist in nature, namely in the human body, e.g. flow through a constricted arterial or blood vessels or peristaltic flow. Such flows occur also in the industry (peristaltic pumps) and in medicine (e.g. in dialysis aparatus or in oxygenator).

Meshless methods are an alternative to the finite element method commonly used in mechanics. The meshless methods applied in the dissertation are so called collocation methods which means that coefficients of an approximate solution are determined by satisfying boundary conditions (or boundary conditions and governing equation) at a finite number of points. The methods used in the dissertation are: the Trefftz method, the method of fundamental solutions and the global radial basis function collocation method.

So far many different numerical methods have been applied for analysis of flows through wavy ducts in the literature, e.g. the finite element method, the boundary element method or the finite difference method. To the best knowledge of the author of the dissertation there are not published research on application of meshless methods for this purpose, except a few recent papers in which the author is a co-author.

The main purpose of the dissertation is to apply selected collocation methods in analysis of flows in wavy conduits and to show their applicability in the considered problems. Five different problems are considered in the dissertation which are: flow in an internally corrugated tube, longitudinal flow between wavy plates, transverse flow between wavy plates, peristaltic flow and flow in an axisymmetric wavy tube. Application of these collocation methods is shown for Newtonian and non-Newtonian fluids. The considered problems are formulated in the pressure-velocity or the vorticity-stream function formulations.