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BLOOD FLOW NUMERICAL SIMULATION USING FE METHOD FOR 2D-AXISYMMETRIC NAVIER-STOKES EQUATION

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Abstract. *According to the World Health Organization, more people die annually from the cardiovascular disease (CVD) that from any other cause in the world. About 44% of these deaths were due to coronary heart disease (CHD) in the United States. For corrective treatments, the percutaneous transluminal coronary angioplasty (PTCA) is a effective minimally invasive procedure, where a small wire tube, called stents, is placed. This work aims to develop a FE code for 2D Axisymmetric Navier-Stokes with species transport equation using semi-Lagrangian scheme and to know how occurs the dynamics of blood flow in coronary artery with atherosclerosis and with stents struts placed. The dynamics of blood flow in coronary artery and possible influence of stents struts with computational fluid dynamics (CFD) requires a robust numerical method to compute the solution of the differential equations in a relevant model. The equations that govern the dynamics of blood flow in a coronary artery were developed according to continuum media assumption. Thus, the universal conservation laws such as conservation of mass, conservation of momentum and conservation of species transport were used in an Eulerian context. The blood was modeled as single-phase, incompressible and newtonian fluid, the diffusion coefficient was considered as constant. The domain was discretized on an unstructured triangular mesh using the GMSH open source. Due to coupling between velocity field and pressure field, the different triangular elements was used, where the linear element was used for pressure field and the MINI element was used for velocity field. The equations were discretized in space by Galerkin formulation and in time, the semi-Lagrangian scheme was used to discretized the material derivative using first order backward difference scheme. The dynamics of blood flow and species transport in coronary artery was investigated in two complex geometry, where the first case is the Curved Channel with Stent, where the atherosclerosis was modeled using a sinusoidal equation to model 40% of channel obstruction and the second case is a Real Channel with Stent and this geometry was obtained through an image processing in an obstructed coronary artery due to the atherosclerosis. In both case, the Reynolds number was calculated using the blood parameters and the Schmidt number was simulated for several cases.*

Keywords: *Navier-Stokes, Axisymmetric, Finite Element Method, Semi-Lagrangian, Drug-Eluting Stent.*