Project Title:

Optimization of Coronary Stent Geometry for Smooth Flow in Arteries

Supervisor's Name:

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Co-Supervisor(s): *(if already known)*

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Sources of Fund:

Not Known.

Research Field(s):

Cardiovascular Diseases, Biomechanics, Computational Fluid Dynamics, Design Optimization

Summary and Problem Statement:

Coronary artery diseases, also known as atherosclerosis, are the most prevalent health problems which may cause severe pain and may leading to heart failure. Coronary artery disease, occurs when excess cholesterol attaches the internal surface of to the walls of the blood vessels. Impedance or blockage of one or more arteries that supply blood to the heart may be fatal and requires immediate medical attention. Blocked arteries are either treat with performing Coronary Artery Bypass Grafting (CABG), balloon angioplasty, atherectomy and placing a metallic stent in the artery to allow flow and unrestricted flow. Stent implantation is a non-surgical method to treat the coronary artery disease that can support arterial walls significantly reduce the risk of heart attack. Study of interaction of blood flow with stent, in-vivo, is extremely challenging as well as risky. Biomechanical interaction of the blood flow and stent under volatile blood flow conditions can be studied by numerical simulations using commercial Finite Element (FE) codes.

Keywords:

Coronary stent, blood flow, Computational Fluid Dynamics (CFD), FE analysis, Design optimization

Objectives:

1. Parametric geometric modeling (geometry with defined parameters for optimization study) of various shapes of coronary stents in CAD software.
2. Modeling flow environment around the stent.
3. Coupling structural and fluid analysis for visualization of flow behaviour and corresponding deformation of the stent simultaneously.
4. A non-linear elasto-plastic material model for stent and hyperelastic material models of artery
5. Optimization of stent geometry for smooth and unrestricted flow of blood with minimum deformation of the stent.

Tentative Methods of Approach:

Required backgrounds and skills
Backgrounds: Mechanics of soft and hard materials, CFD, Multiphysics analysis
Computing Skills: ANSYS, ABAQUS, SOLIDWORKS, PRO-E etc
Other requirements:

References: