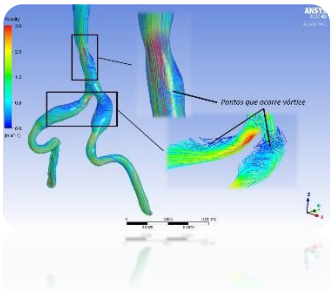

Blood Flow Modeling - a CFD application

Course Title: Blood Flow Modeling – a CFD application

Professor: Flavia Zinani – UNISINOS, Brazil

Summary: The analysis and simulation of blood flow by CFD (Computational Fluid Dynamics) have provided results that show great potential to aid the diagnosis and treatment of diseases such as atherosclerosis. The analysis of the effects of restrictions due to stenosis and the fluid dynamic analysis of systems with arterial grafts microscopic and detailed view of the physical phenomena involved in blood flow through vessels and arteries. This view can be helpful for more effective surgical techniques. In addition, advanced image processing techniques have made it possible to generate computer models for patient-specific vessels from imaging exams (CTA – computed tomography angiography), which complements the results obtained in idealized geometries, aiding in the diagnosis and treatment of cardiovascular diseases. In this course, an overview of the possible applications of CFD for blood flow analysis will be provided, in addition to presenting the main physics involved and the alternatives for mathematical modeling of the systems. Topics such as blood rheology, the lag between pressure and flow pulses, vessel elasticity, and fluid-structure interaction will be addressed. Furthermore, applications of the Constructal Design Method in blood flow problems will be reviewed. Finally, the codes used to build geometric models and numerical simulations will be discussed.

Objectives

1 – Introduce the science of hemodynamics and the horizon of simulation in vascular medicine.

2 – Present an overview of the most important physical phenomena involved in blood flow and the mathematical modeling of such phenomena.

3 – Introduce the students to a basic simulation of blood flow using a commercial CFD code.

Course outline

Lesson	Date	Contents	Bibliography
1	Tuesday, January 17th 2:00 – 4:00 p.m.	Introduction to CFD; CFD Applications in hemodynamics.	[1] [2]
2	Thursday, January 19th 2:00 – 4:00 p.m.	Blood as a fluid; Blood rheology.	[3] [4]
3	Monday, January 23rd 2:00 – 4:00 p.m.	Hands-on activity: flow through an idealized artery with a stent; Measurements of uncertainties in CFD.	[5]
4	Wednesday, January 25th 2:00 – 4:00 p.m.	Important measures in hemodynamics; Hands-on activity: pulsatile flow through an artery with a stent.	[6] [7] [8] [9]
5	Thursday, January 26th 2:00 – 4:00 p.m.	Fractional flow reserve; Hands-on activity: flow through a patient-specific artery with a bifurcation.	[10]
6	Thursday, February 2nd 2:00 – 4:00 p.m.	Constructal Law and Constructal Design; Course Summary.	[11] [12]

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