MECH 691X: APPLIED CADIOVASCULAR FLUID DYNAMICS
WINTER 2009

[This graduate course is open to 3rd or 4th year undergraduate students upon selection]

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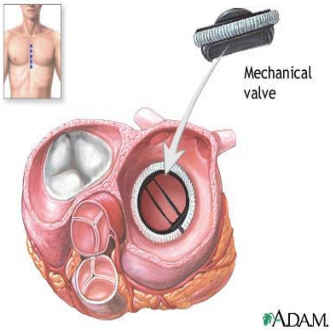
OBJECTIVE

Physiology of the heart and the arterial system, steady and unsteady flow models, wave phenomena, lumped parameter mathematical models, flow and pressure measurement, velocity measurement, cardiac simulators, cardiovascular devices, physics of medical imaging for in vivo velocity measurement, coronary blood flow, microcirculation. Project on specific topic or applications.

PREREQUISITES: Fluid Mechanics
Numerical methods.



Review of Basic Fluid Mechanics Concepts
- Mass conservation
- Momentum conservation
- Energy conservation
- Dimensional analysis and scaling

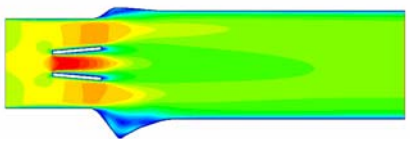
Mathematical and Computational Modeling of the Arterial System
- Physiology of the heart and the arterial system
- Steady and unsteady flow models
- Wave phenomena
- Flow, pressure and pathologies of the cardiovascular system
- Lumped parameter mathematical models

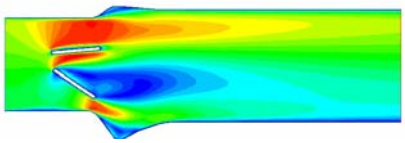
Experimental Analysis of the Cardiovascular System
- How to measure the flow?
- How to measure the pressure?
- How to measure the velocity (LDA, PIV and micro-PIV)?
- How to build and test a cardiac simulator?

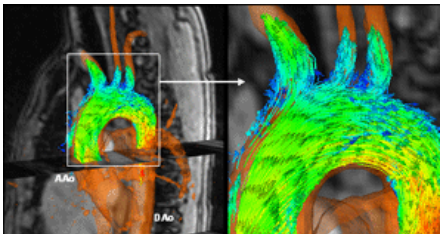
Physics of Medical Imaging for *in vivo* Velocity Measurement
- Doppler effect and ultrasounds velocity measurement
- Phase contrast magnetic resonance imaging for velocity measurement

Coronary Blood Flow
- Morphology of coronary arteries
- Pressure-Flow relationship of coronary circulation
- Mathematical modeling of coronary blood flow

Micro-Circulation
- Anatomy of microvascular beds
- Properties of blood
- Rheology of blood
- Hypertension







REFERENCES

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- W. Nichols and M. O'Rourke. McDonald's Blood Flow in Arteries: Theoretical, Experimental and Clinical Principles. 5th edition (2005). Hodder Arnold Publication.
- J. Mazumdar. An Introduction to Mathematical Physiology and Biology. 2nd edition (1999). Cambridge University Press.

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