Molecular, Cellular & Tissue Biomechanics

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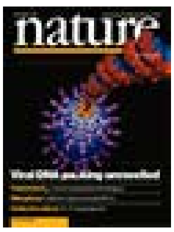
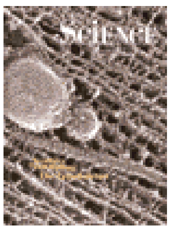
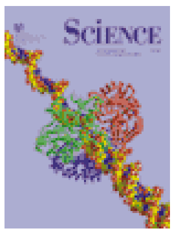
Goal: Develop a *fundamental* understanding of biomechanics over a wide range of length scales.







MOLECULAR MECHANICS

I Biomolecules and intermolecular forces
II Single molecule biopolymer mechanics
III Formation and dissolution of bonds
IV Motion at the molecular/macromolecular level

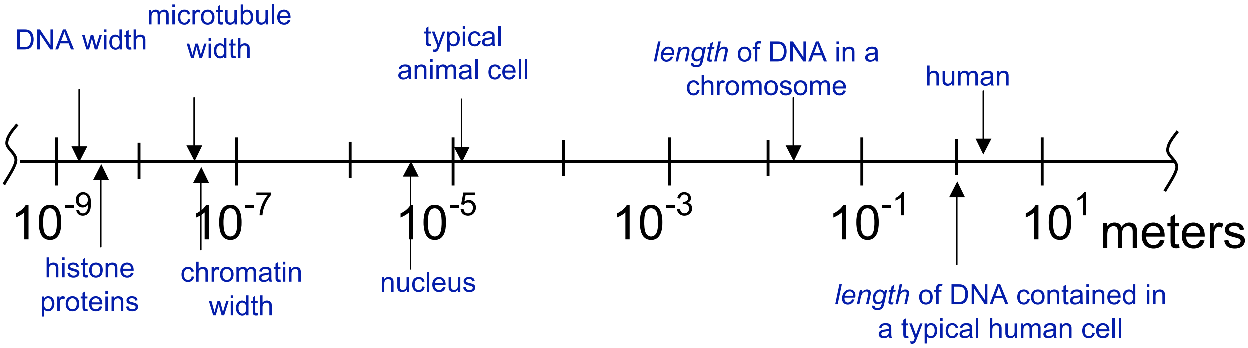
TISSUE MECHANICS

I Molecular structure --> physical properties
II Continuum, elastic models (stress, strain, constitutive laws)
III Viscoelasticity
IV Poroelasticity
V Electrochemical effects on tissue properties

CELLULAR MECHANICS

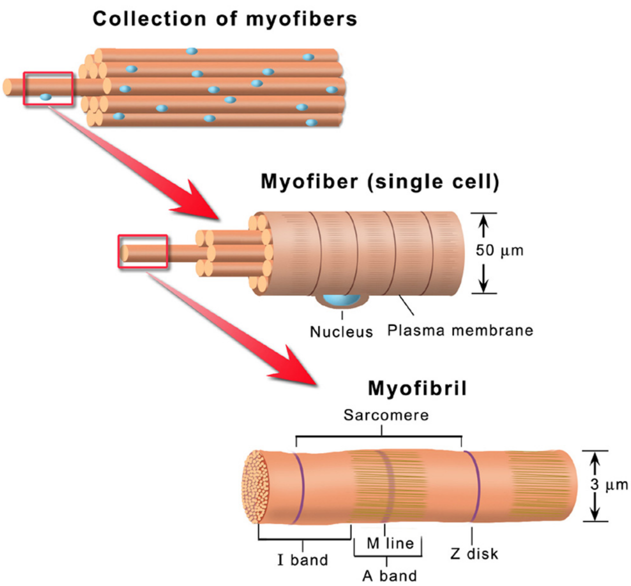
I Structure/function/properties of the cell
II Biomembranes
III The cytoskeleton
IV Cell adhesion and aggregation
V Cell migration
VI Mechanotransduction

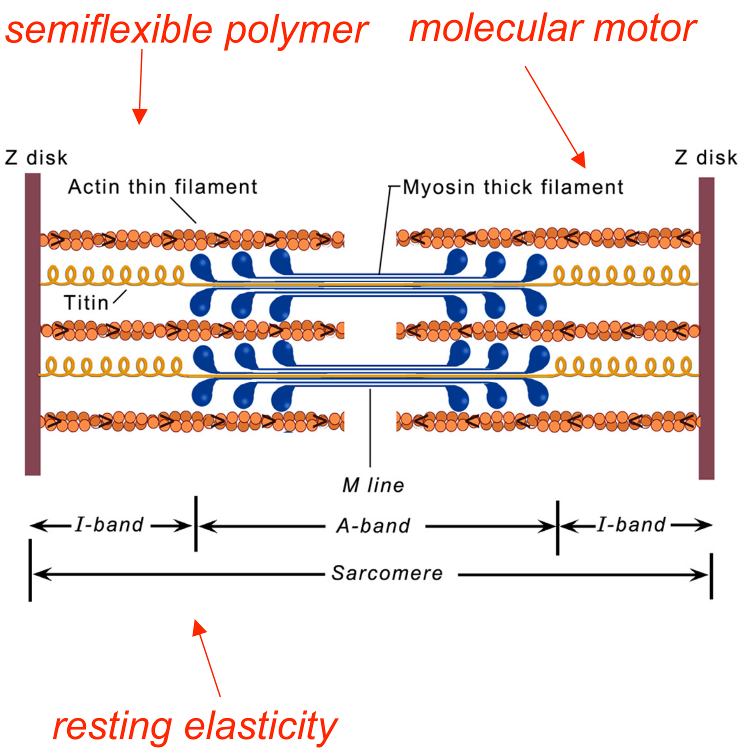
Typical Length Scales in Biology



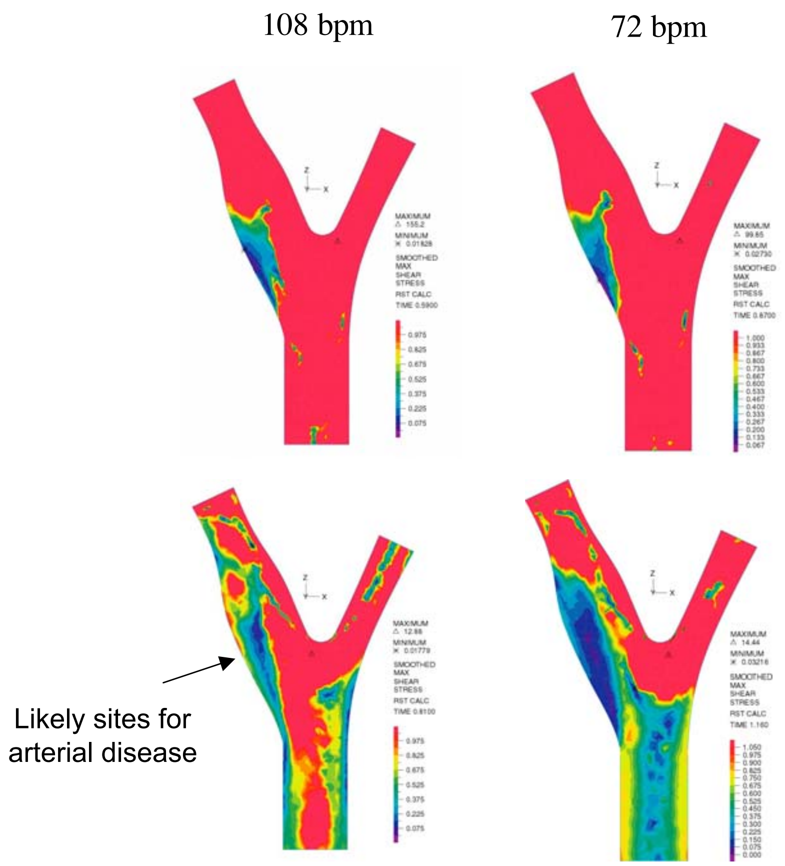
Similar spectra exist in time scales or energy scales.

Muscles: Spanning from Macro to Nano





Macro-scale applications



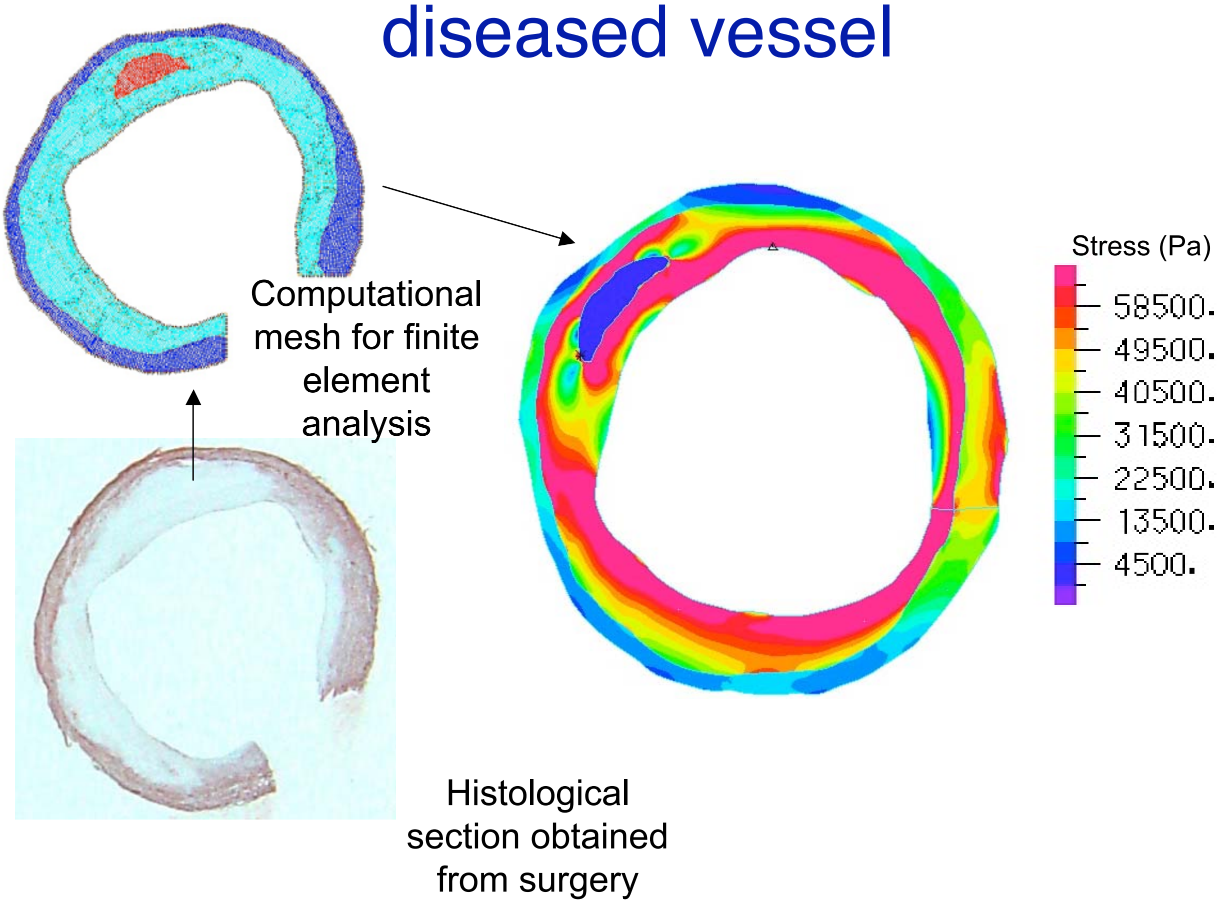
Cardiovascular mechanics

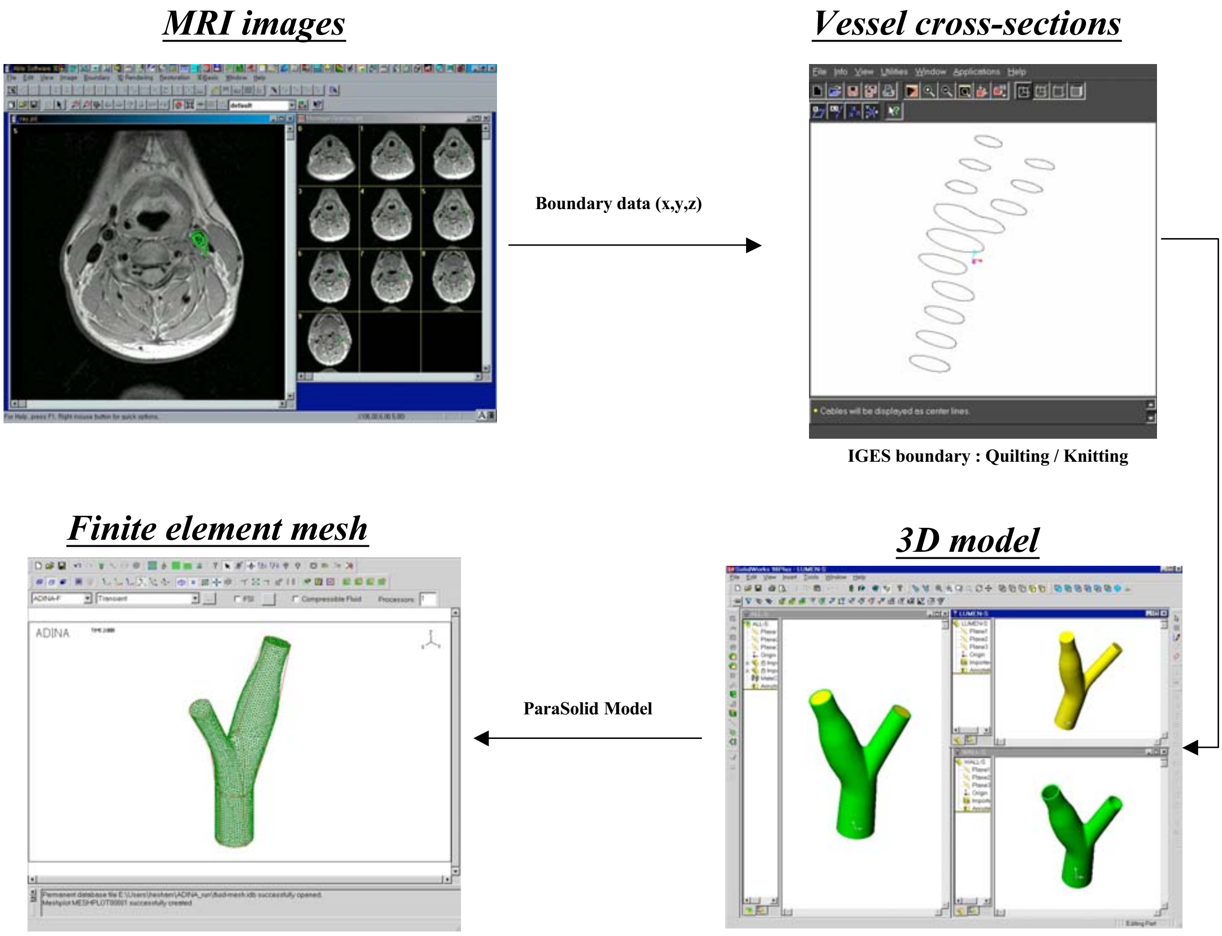
Computational fluid mechanics used to study shear stresses in the carotid artery

Peak flow

Maximum deceleration

…or tissue stresses in the wall of a diseased vessel




MRI images
Vessel cross-sections
Boundary data (x,y,z)
IGES boundary : Quilting / Knitting
Finite element mesh
3D model
ParaSolid Model
ADINA
Cables will be displayed as center lines.