

Simulation of Cardiac Ischemia and Arrhythmias

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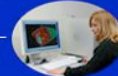
CVRTI

Nora Eccles Harrison Cardiovascular Research and Training Institute 

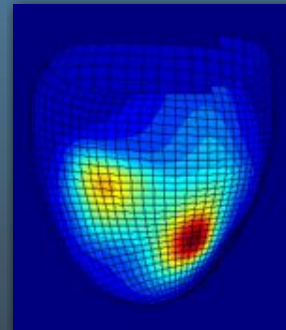
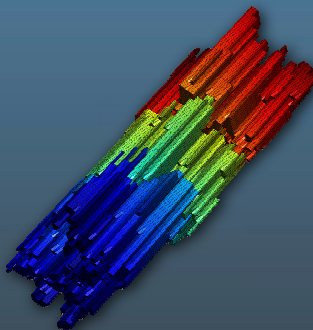
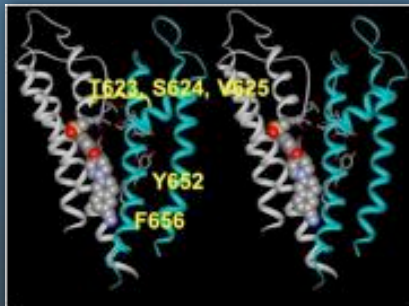
Molecular



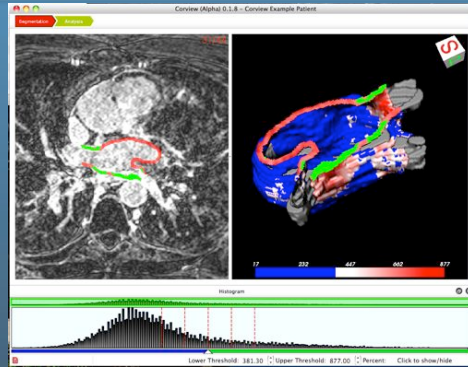
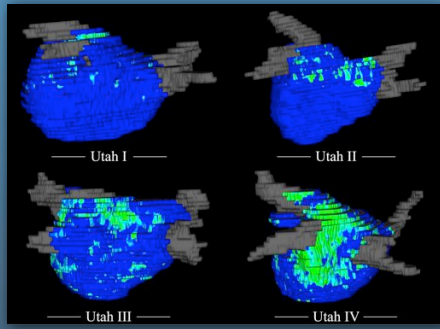
Cellular



Whole Organ



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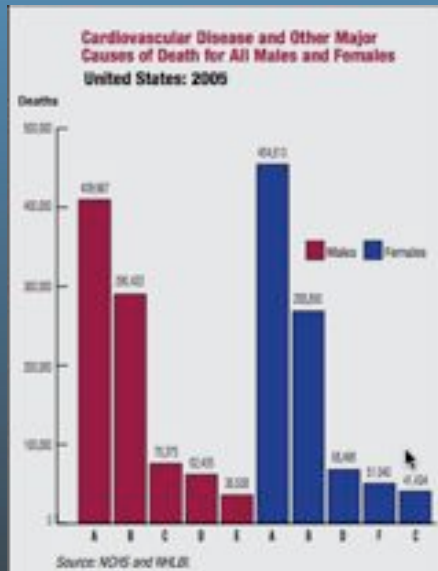


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Heart Disease is a Killer



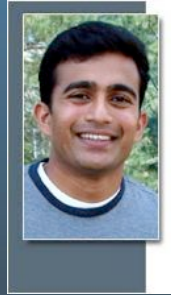
Males	
CVD+Congenital Cardiovascular Defects	A
Cancer	B
Accidents	C
Chronic Lower Respiratory Disease	D
Diabetes	E
Females	
CVD+Congenital Cardiovascular Defects	A
Cancer	B
Chronic Lower Respiratory Disease	D
Alzheimer's	F
Accidents	C

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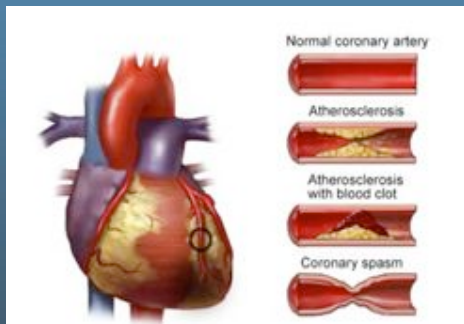
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Simulation of Ischemia



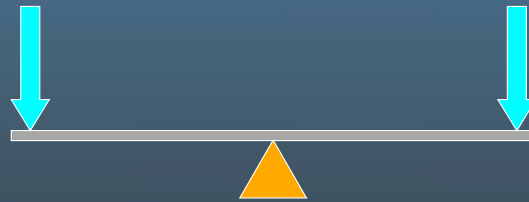
Ischemia



Coronary Supply versus Demand

Supply

Demand



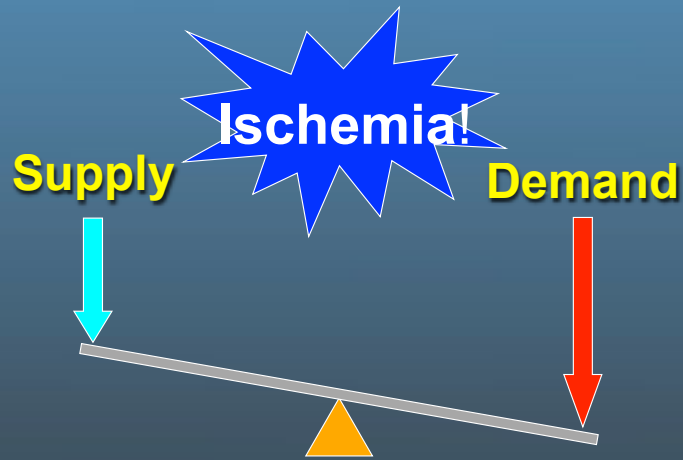
Coronary Supply versus Demand

Supply

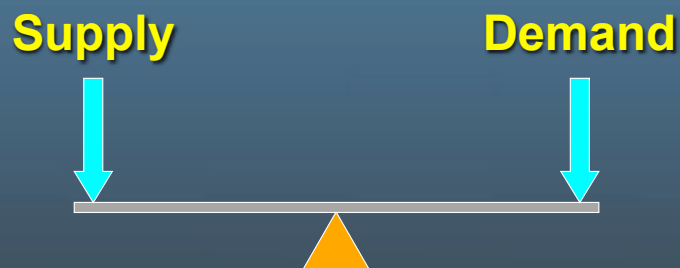
Demand



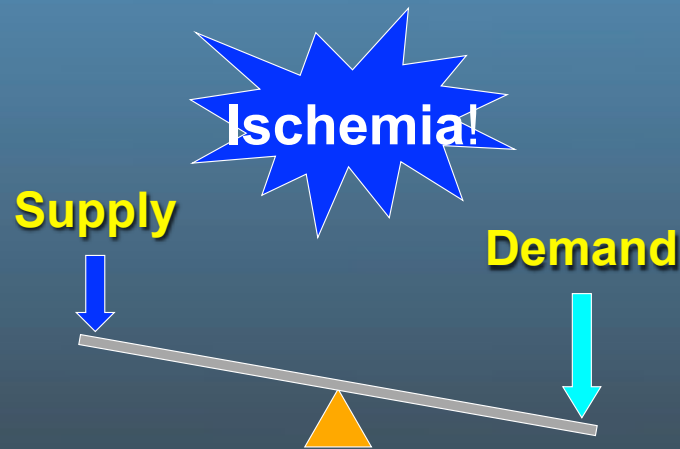
Coronary Supply versus Demand



Coronary Supply versus Demand



Coronary Supply versus Demand

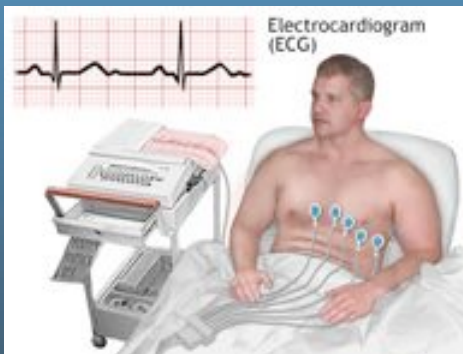


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Heart Attacks and the ECG



Continuous monitoring:

- ◆ 30-50% error rate
- ◆ Lead locations unclear, suboptimal
- ◆ Tracks changes dynamically

Stress testing

- ◆ Low sensitivity/specificity
- ◆ Thresholds variable
- ◆ Tracks changes during stress

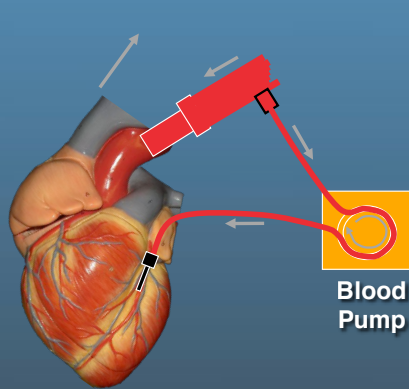


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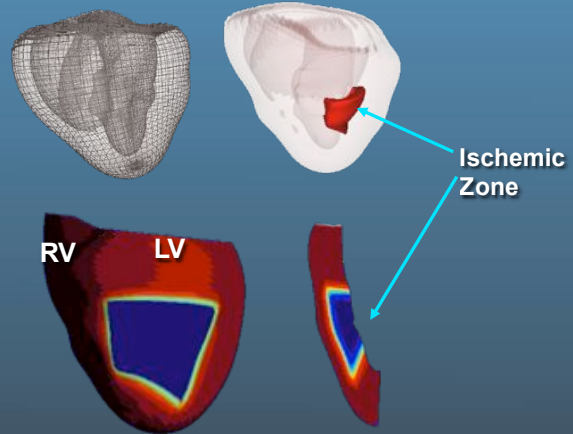
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Experiments and Simulations



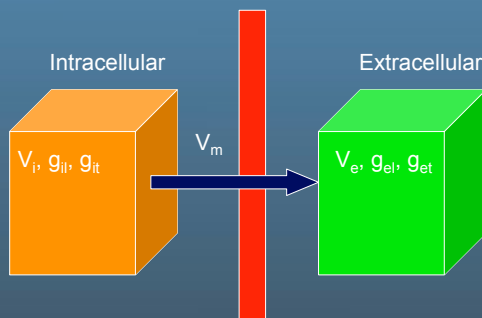
Shome et al. IEEE EMBS, 2004



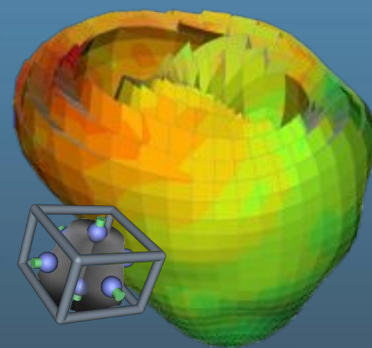
Hopenfeld et al. JCE, 15:1200, 2004



Simulation of Ischemia



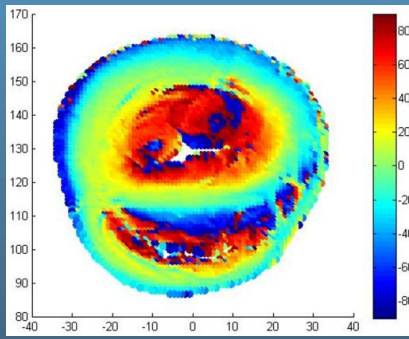
Bidomain Approach



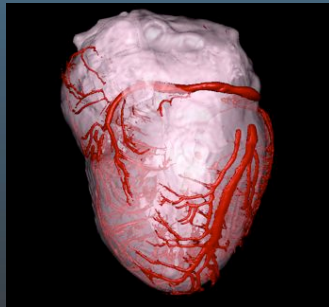
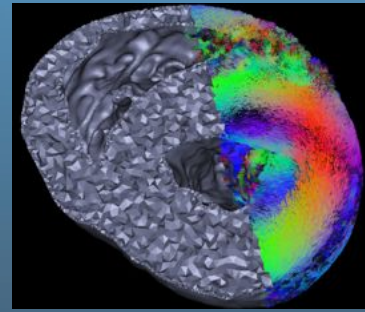
Embed Ischemia



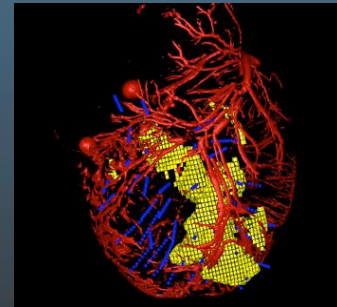
Model Making



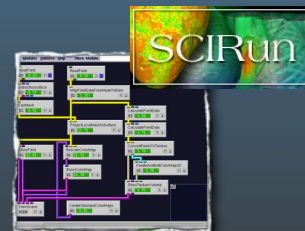
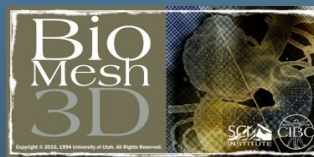
DTI



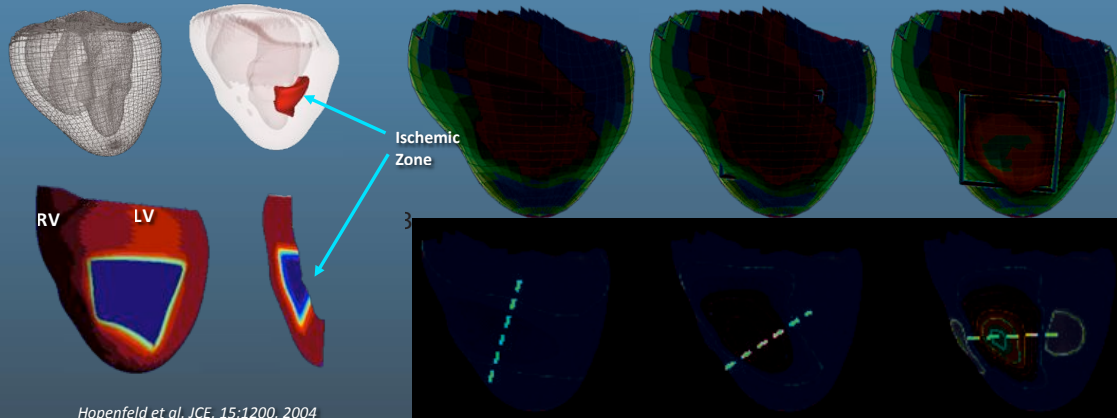
Vasculature



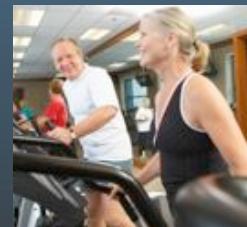
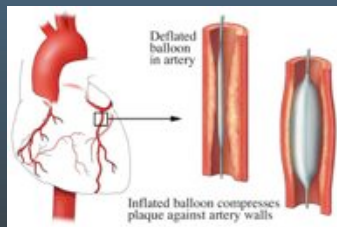
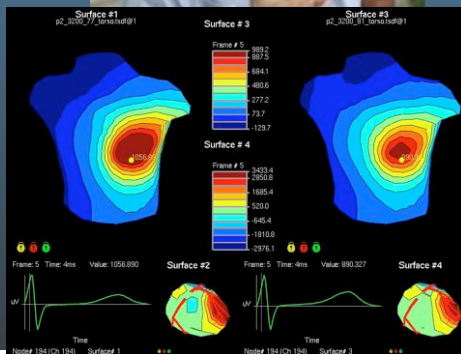
The Tools



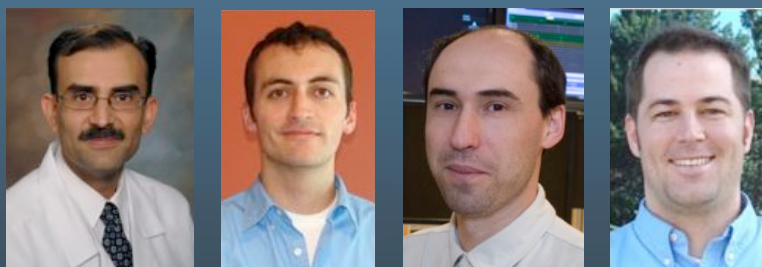
Comparing Models to Experiments



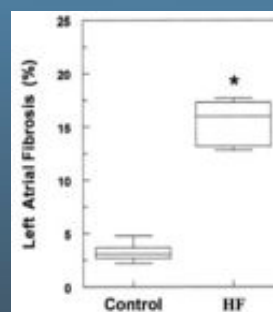
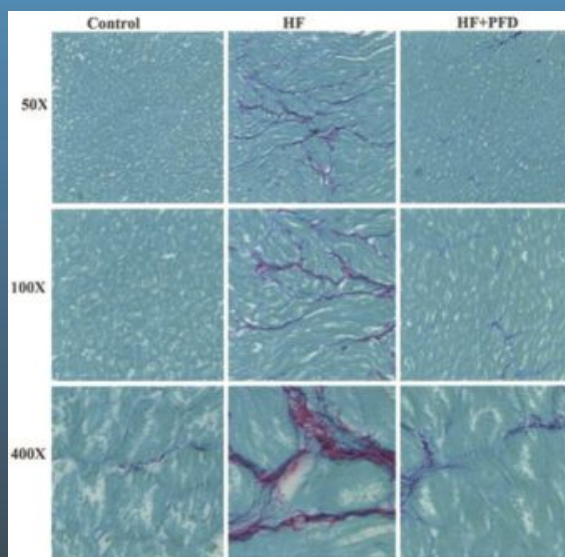
The Goal



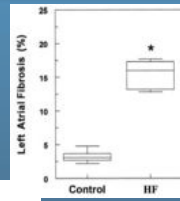
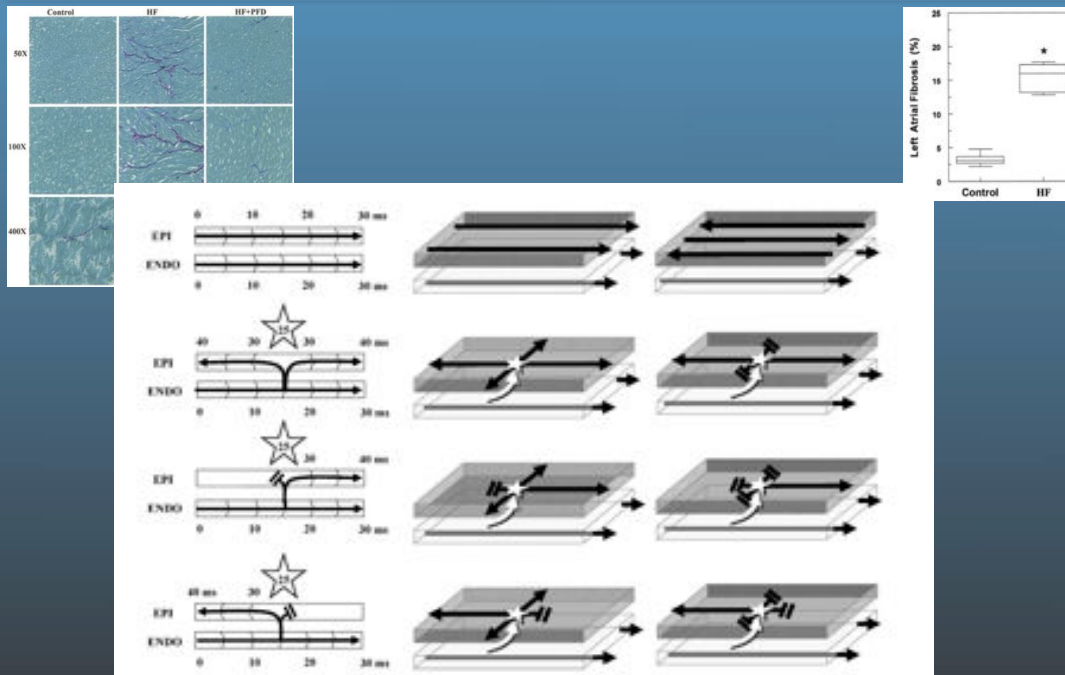
Simulation of Atrial Arrhythmias



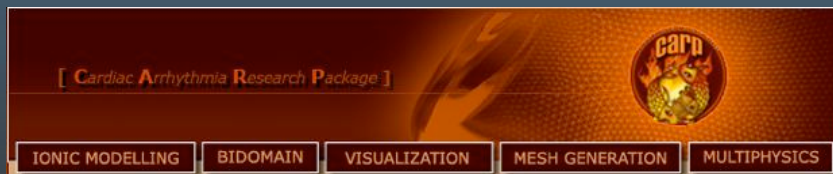
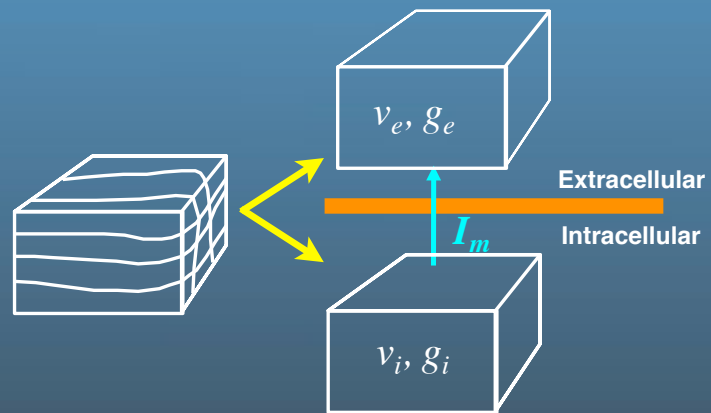
Fibrosis Linked to AF



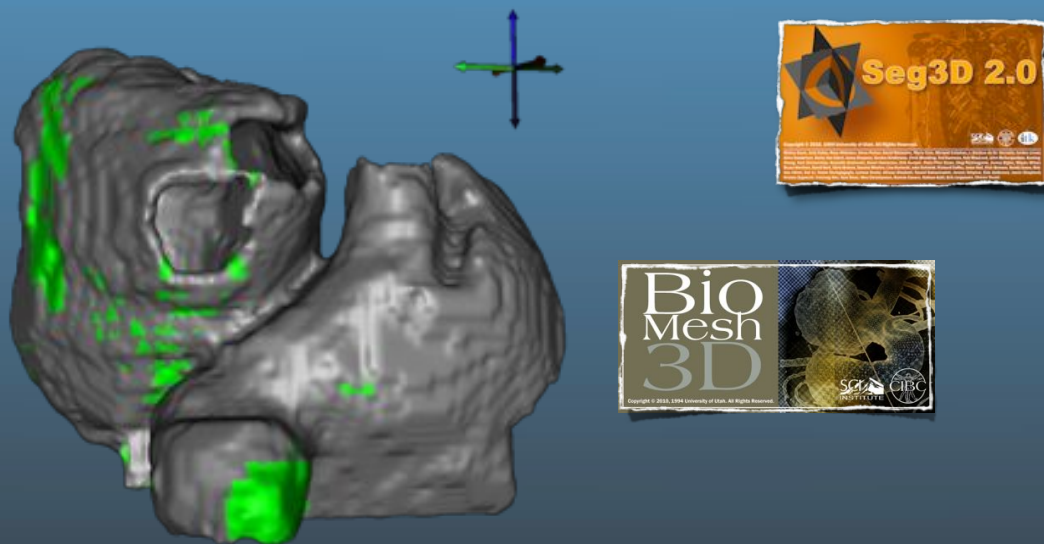
Fibrosis Linked to AF



Modeling Approach



Model Construction



Initial Results

