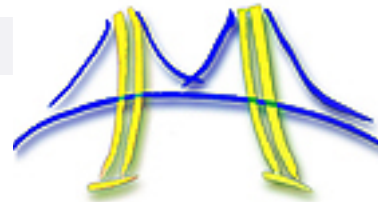


Personalized Medicine from Medical Imaging and Advanced Computation

Tobias Harrison-Noonan

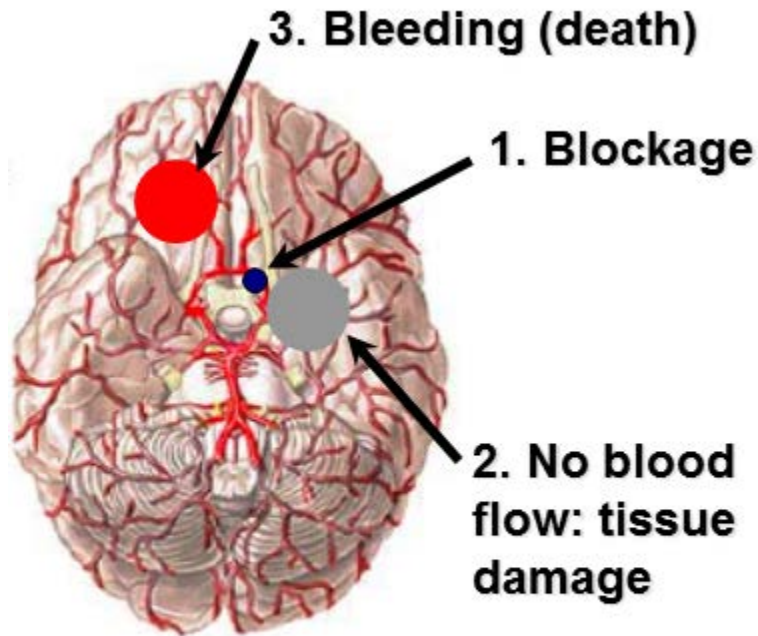
Parlab Bootcamp, August 17, 2012

Project Objectives

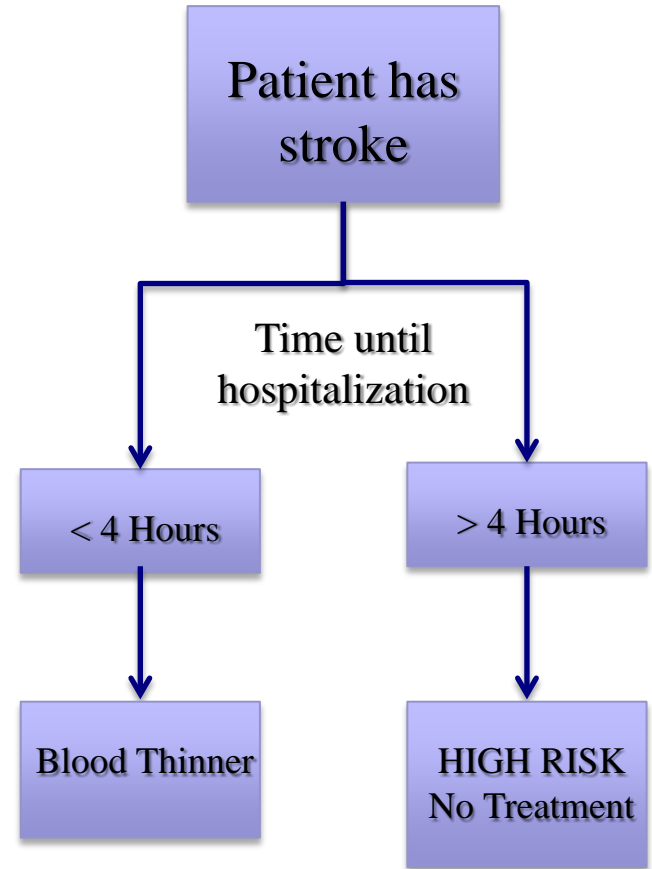


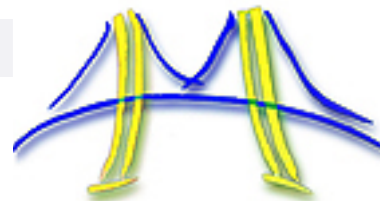
■ Problem:

- Short treatment window
- Stroke treatment not quantitative



Bottom view of brain





The Vision...

Medical Imaging

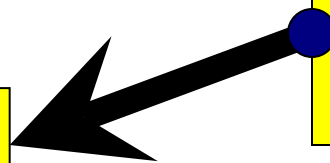
+

Computation

+

Biomechanics

**CLINICAL
FUNCTION**



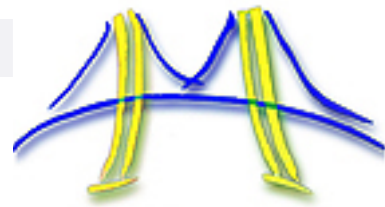
Improved Healthcare

Diagnostics

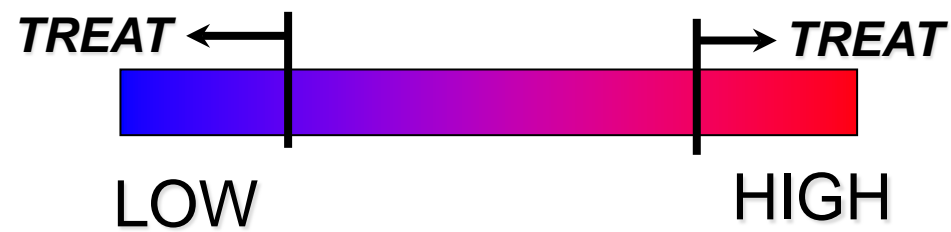
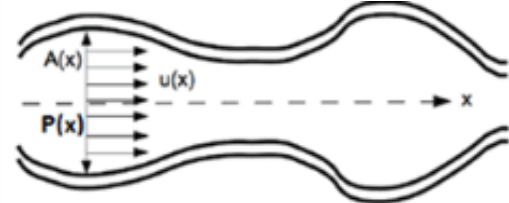
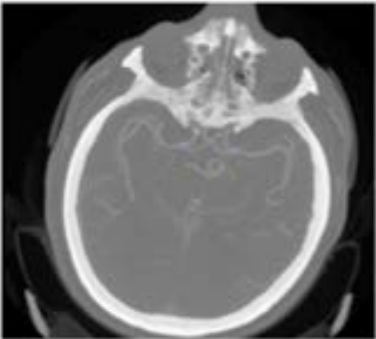
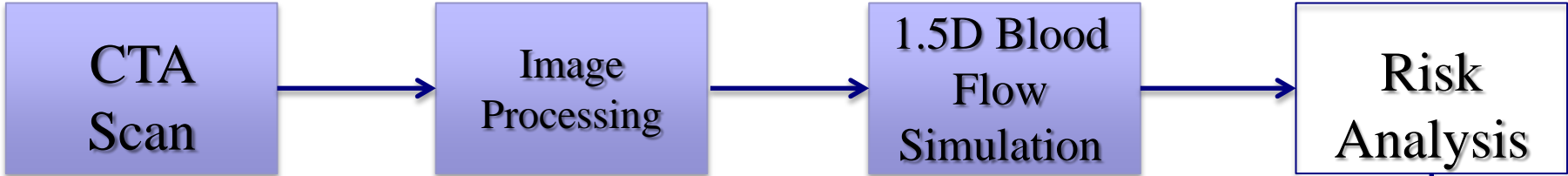
Surgical Planning



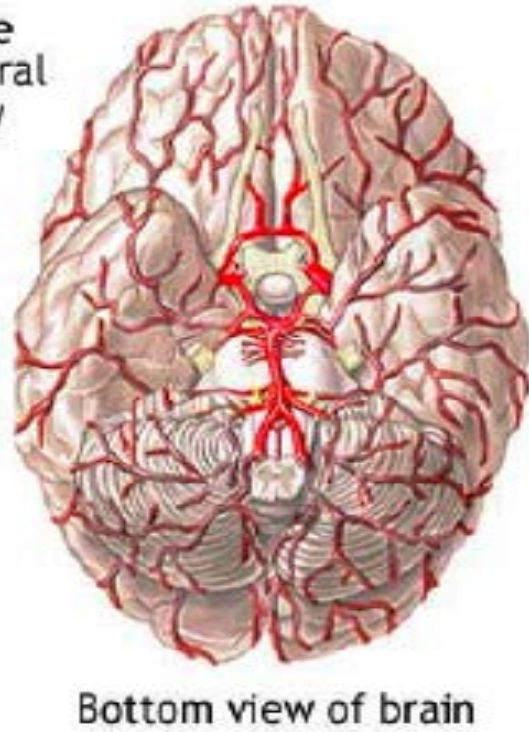
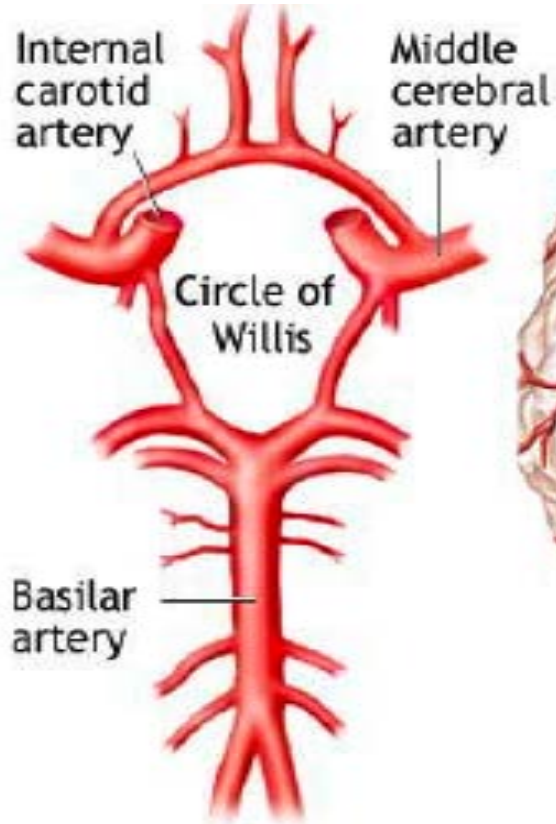
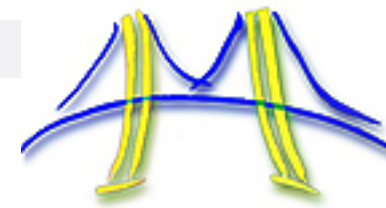
Our Solution



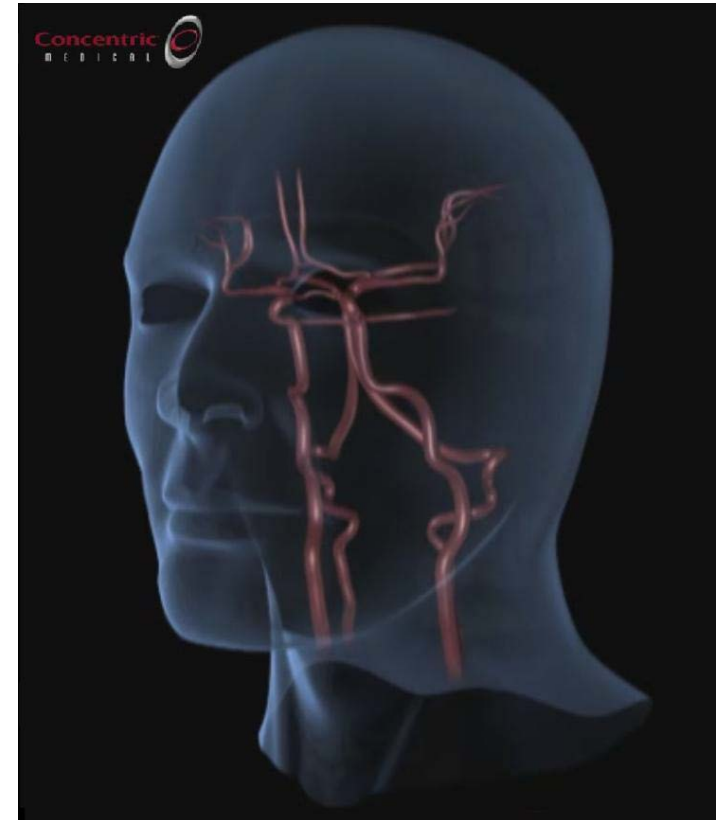
60 seconds



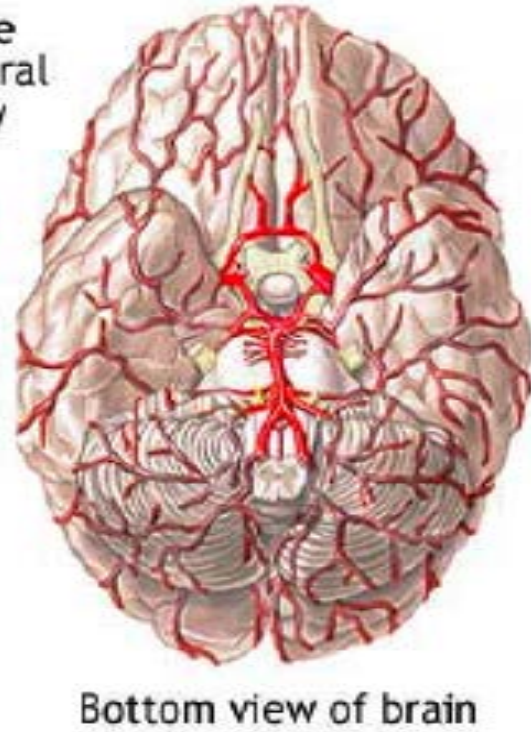
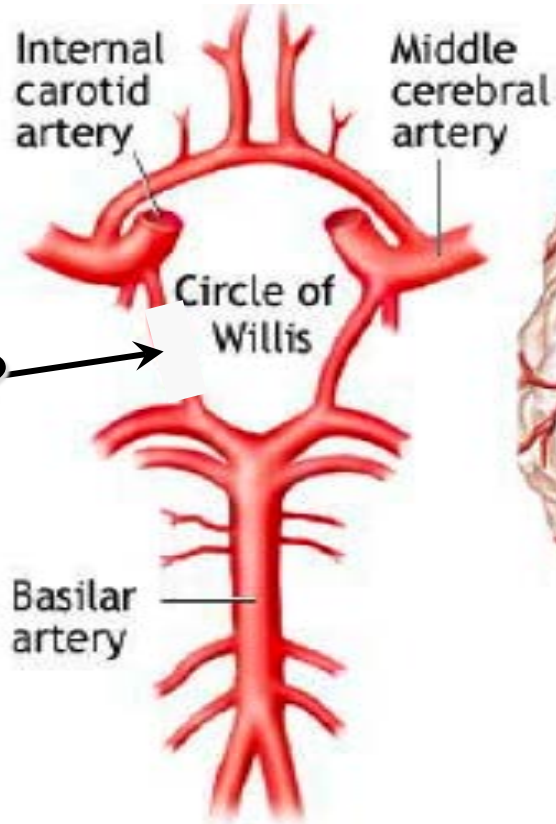
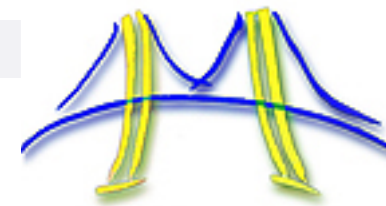
Circle of Willis



ADAM



Circle of Willis



ADAM

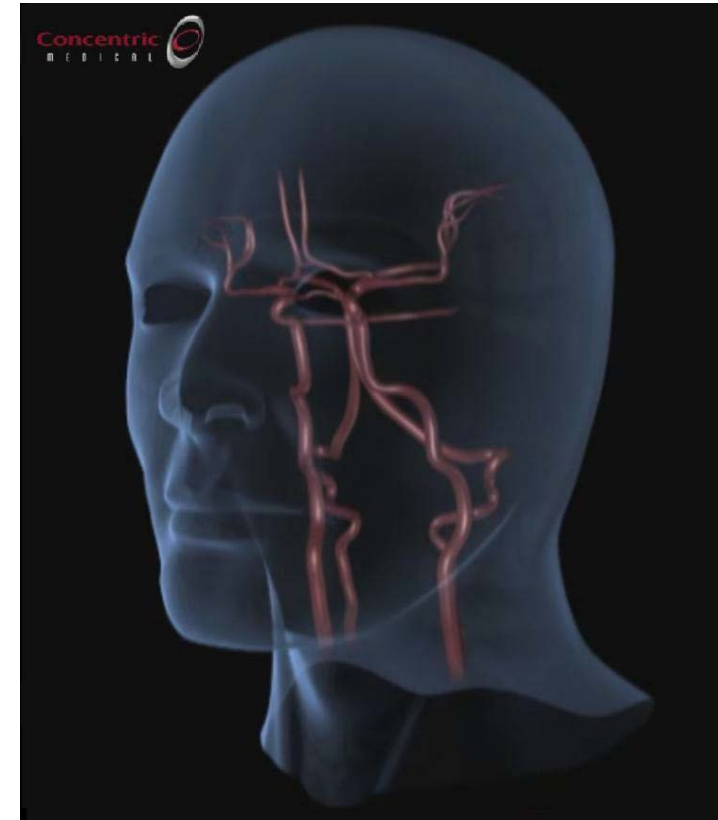
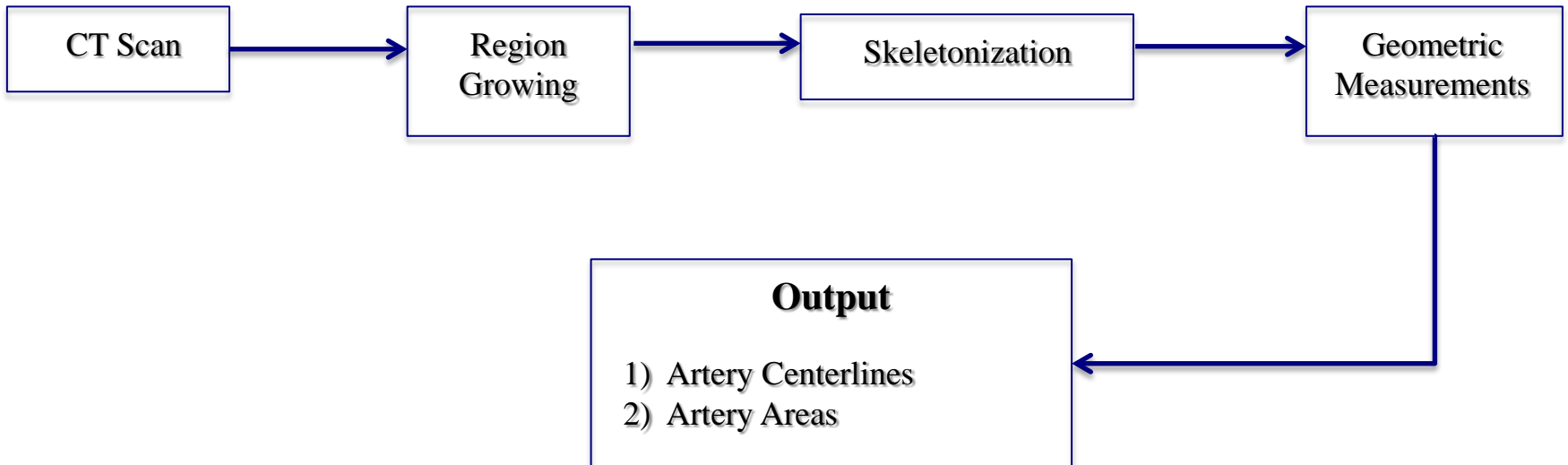
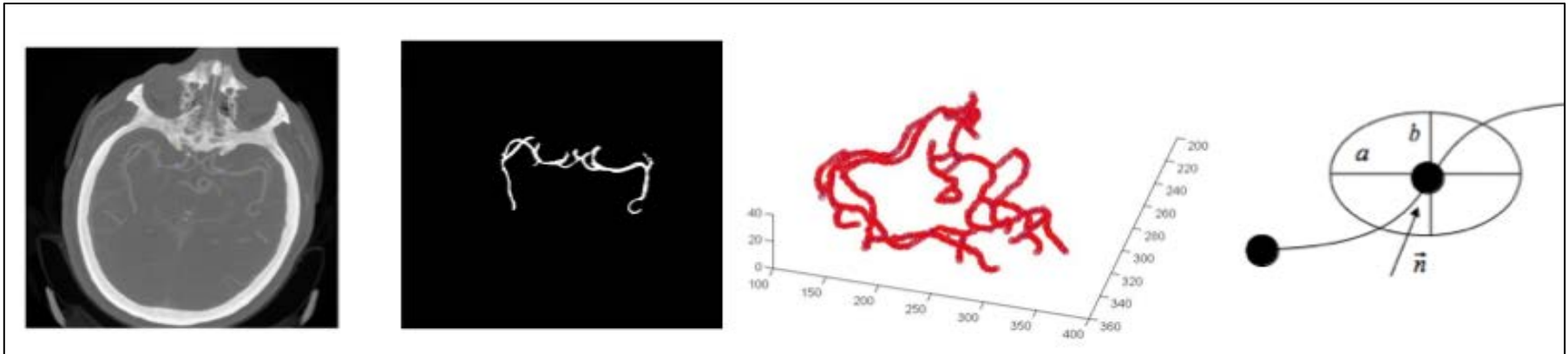
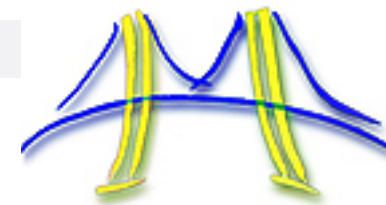
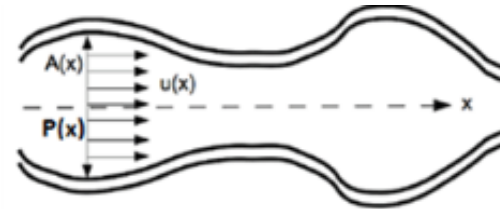
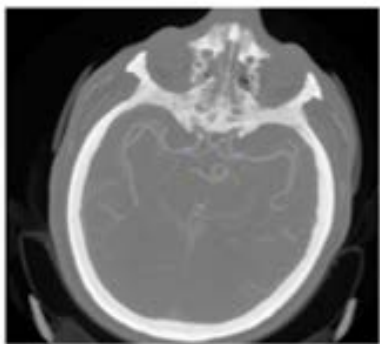
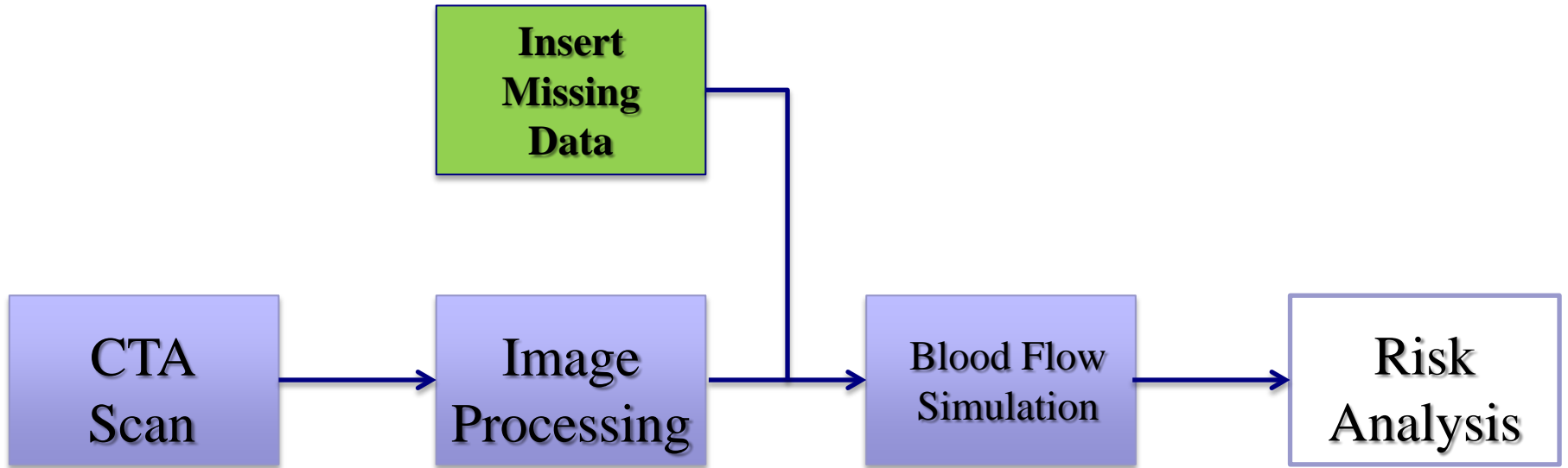
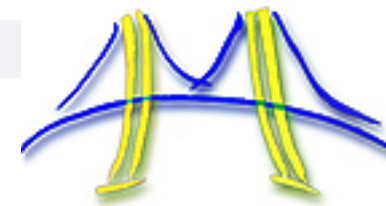


Image Processing

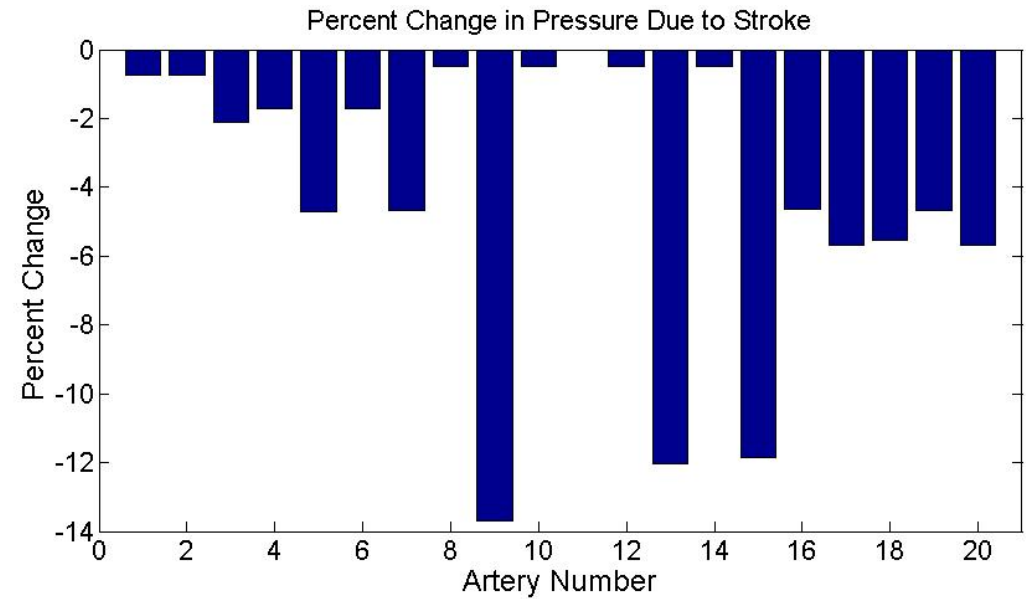
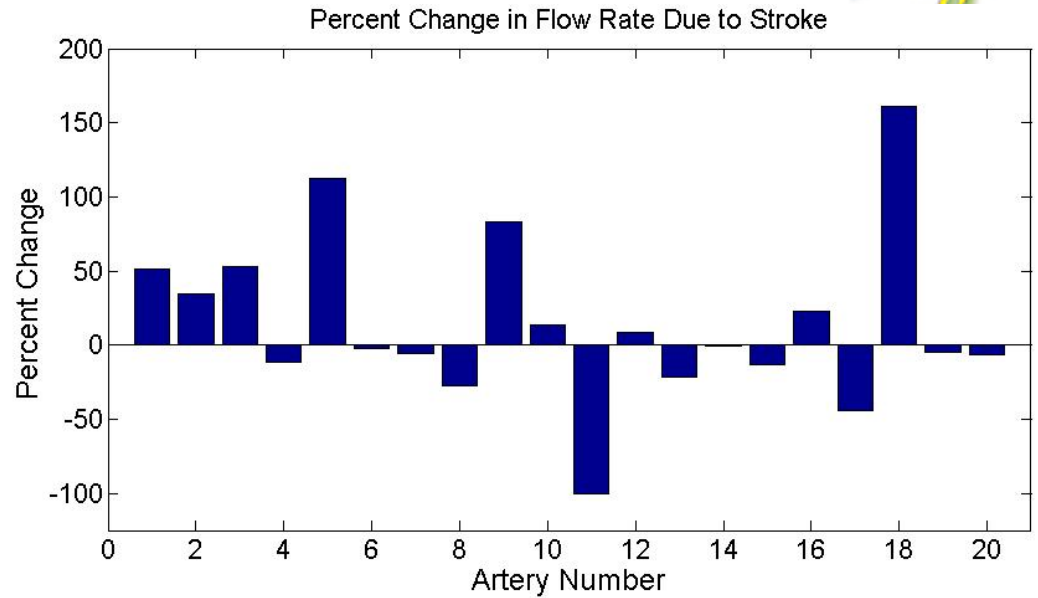
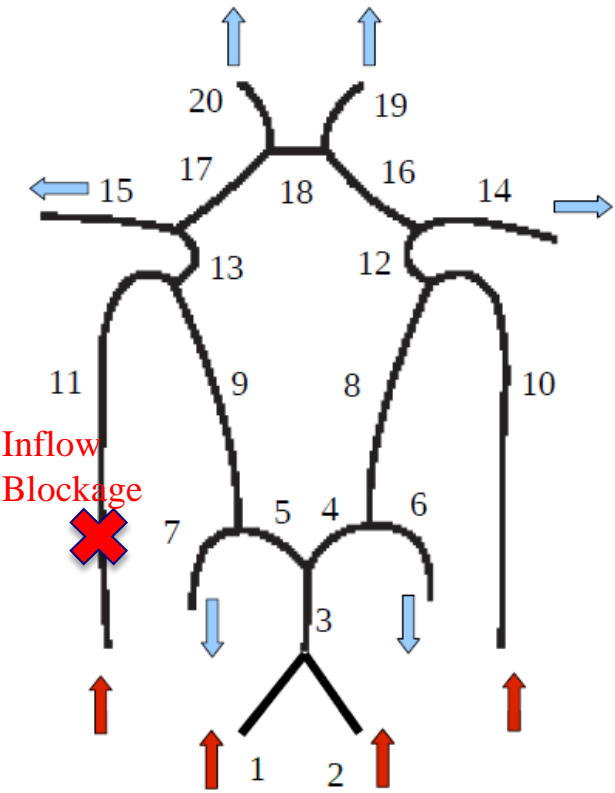
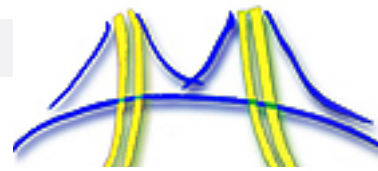


Library Template Technique

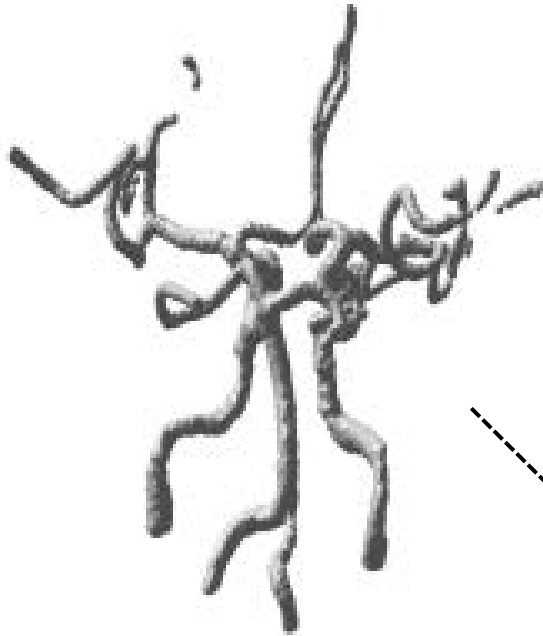
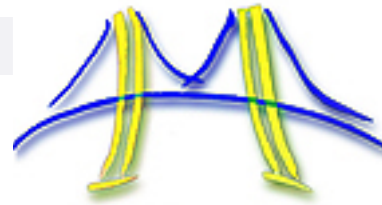


Low Risk?
High Risk?

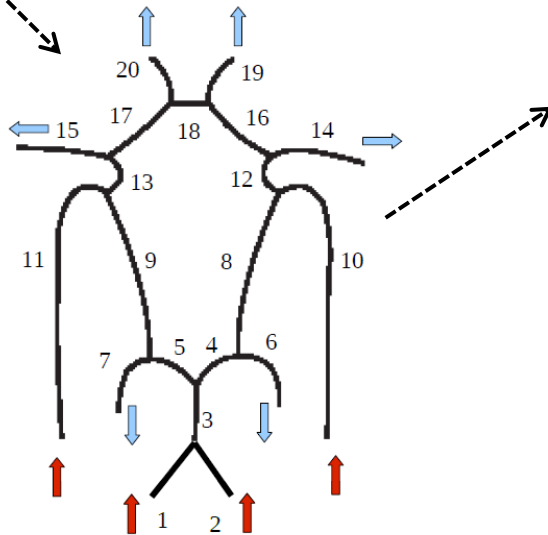
Results



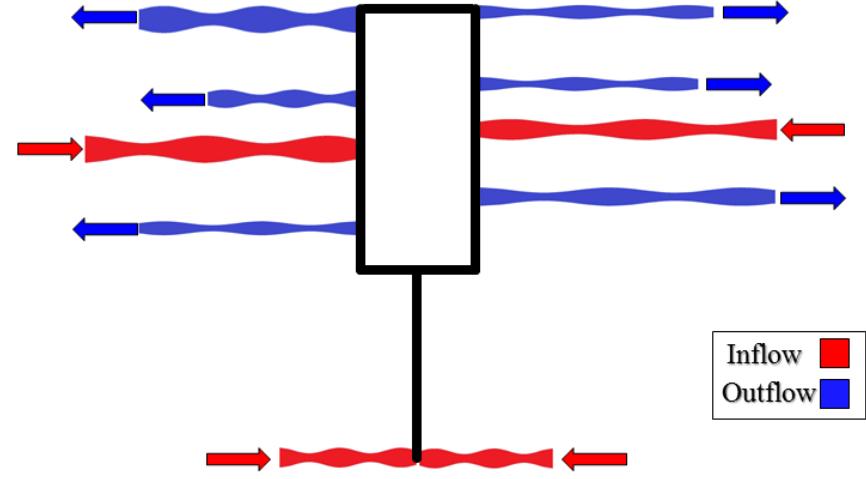
Template Model



Circle of Willis

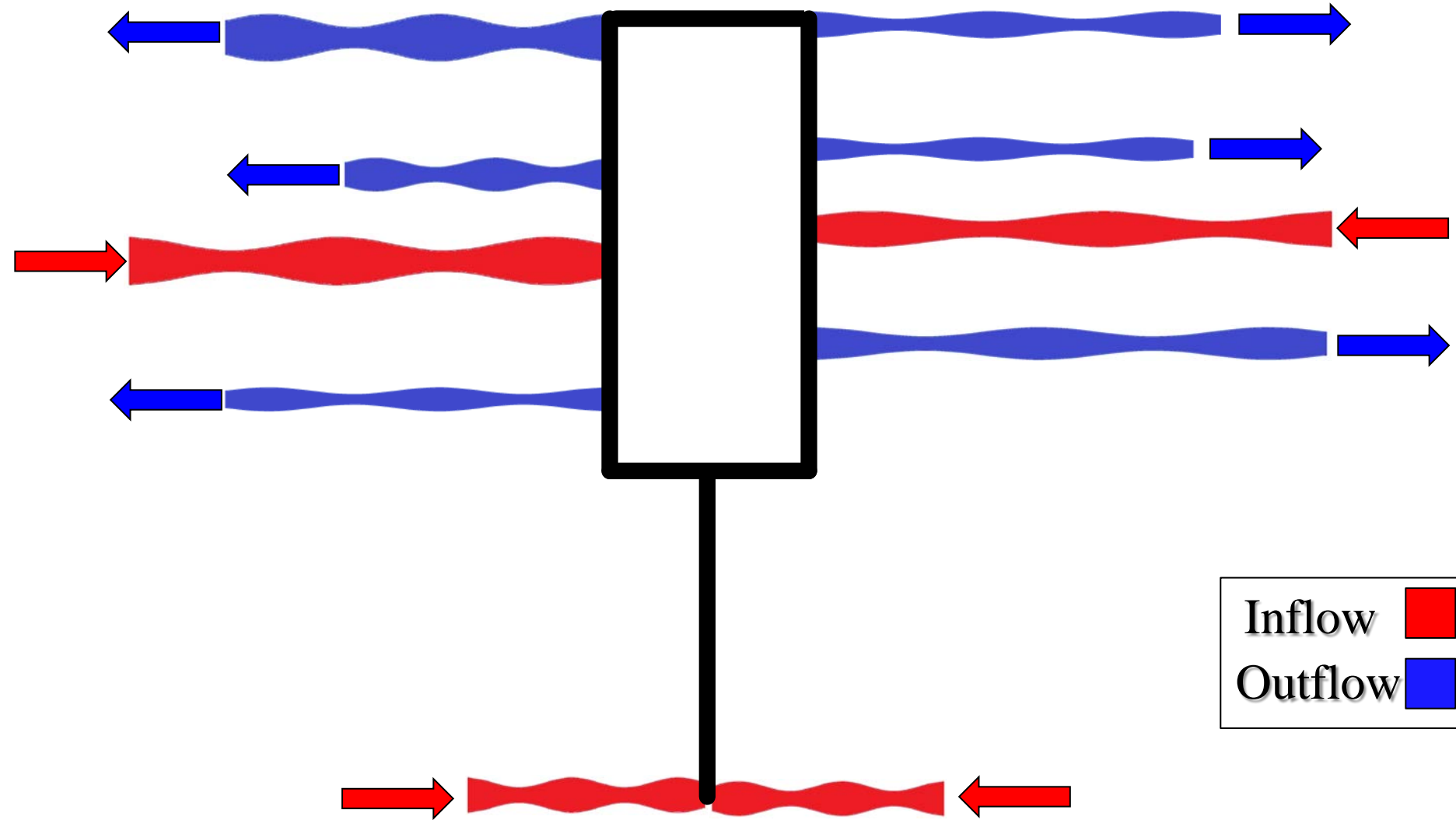
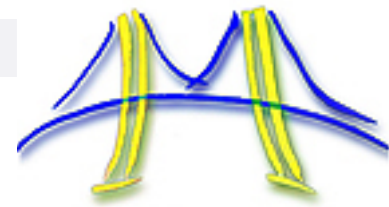


Template

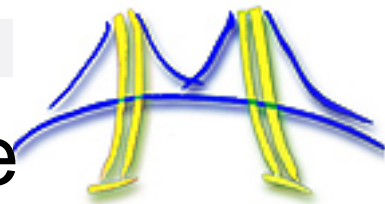


1.5D Model

1.5D Fluid Flow Model

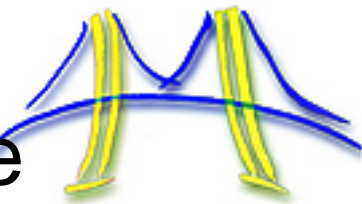


1.5D Blood Flow Problem Size



- ❖ # Grid points: $O(10^4)$ [0.1mm spacing]
- ❖ # Time steps: $O(5 \cdot 10^6)$ [10 μ s step size]
- ❖ 1D Structured Grid
- ❖ Flops / Point: $O(160)$
 - ❖ 45 x
 - ❖ 30 +
 - ❖ 15 divide
 - ❖ 3 sqrt
- ❖ Time Allotted: $O(30s)$
- ❖ Gigaflops / sec: $O(260)$
- ❖ Original MATLAB Code
 - ❖ Megaflops/sec $O(440)$

Image Processing Problem Size



❖ Image Size: [512,512,400] 16 bit

❖ Time scales:

- Current Implementation

- Total time for processing: O(1 hour)
- Object Identification: O(1 hour)
- The rest: O(5 minutes)

- Goal

- Total time: O(30s)

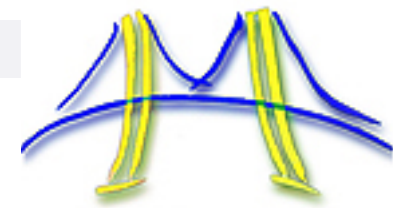
❖ Implementation Plan

- Automate Object Identification

- Define exemplars, extract features, classify

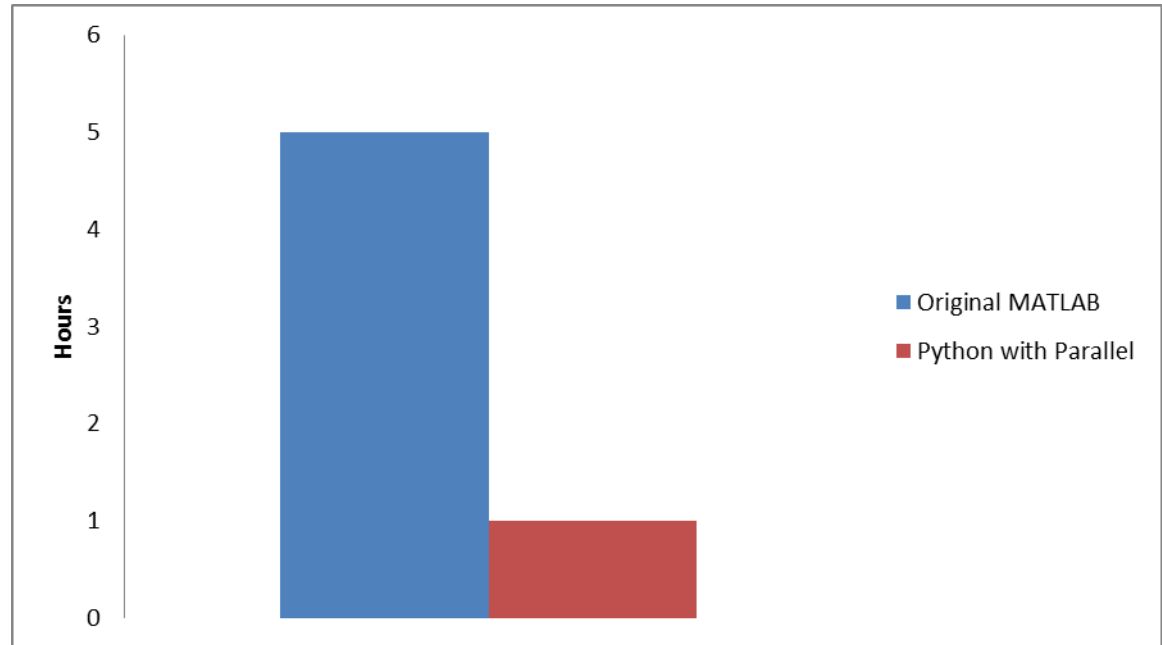
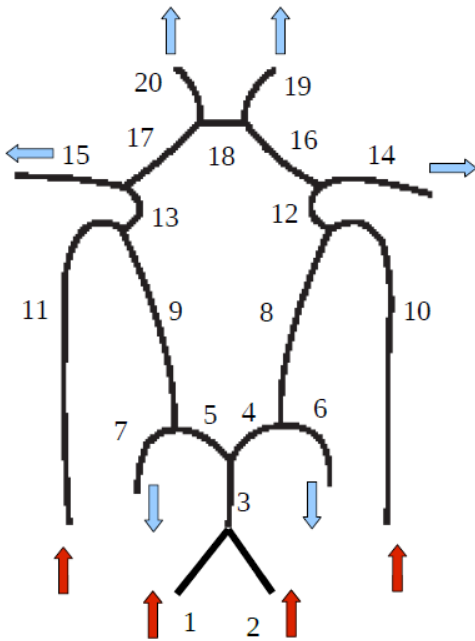
- Use SEJITS framework

Performance Improvements

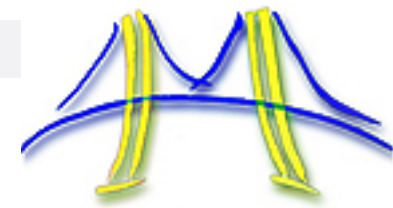


Python Version

- Each artery in parallel

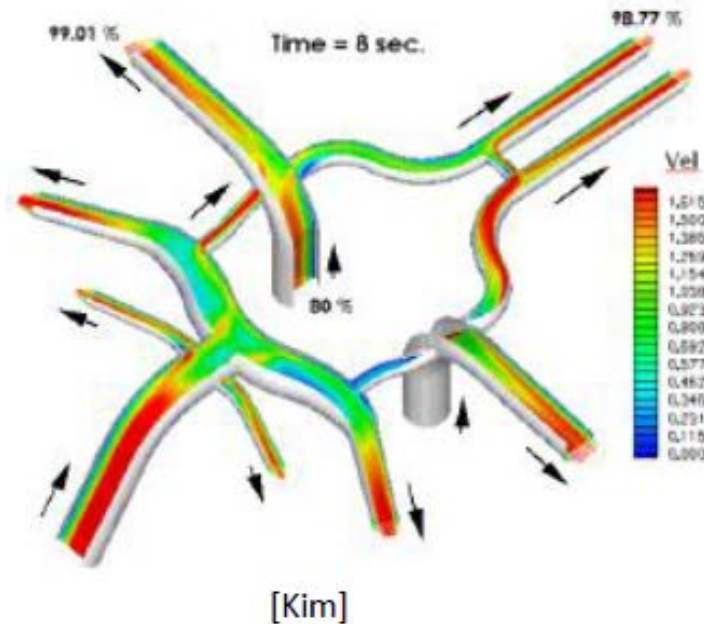


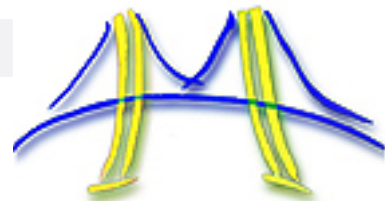
Retrospective Study



■ Patient Scans

- Predict outcomes of mechanical thrombectomy treatments
- ~150 Patients
 - Neurological score (modified Rankin scale) at 90 days





The Parlab Health-App Team

Primary Faculty

Tony Keaveny
Jim Demmel
Panos Papadopoulos
Armando Fox
Kathy Yelick

LBL Collaborators (3D fluids)

Phil Colella
Terry Ligocki
Dan Graves

UG Students

Akash Jain
Sam Schneider
Timothy Lee
Eric Yu

Other Faculty

Max Wintermark
Chelsea Kidwell
David Saloner
Stan Berger
Mohammad Mofrad
Mark Adams

Students

Tobias Harrison-Noonan
Meriem Ben Salah
Razvan Carbunescu
Chris Chaplin
Florian Hecht
Andrew Gearhart
Brian van Straalen