WP3:
Visualization

culty and staff:

LSU CCT+CS: B. Ullmer, W. Benger, A. Hutanu, J. C

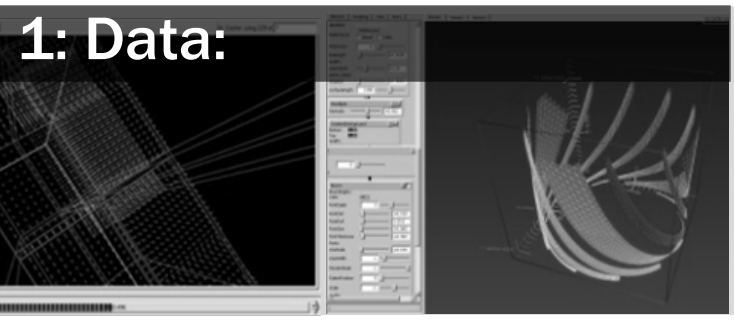
ULL/LITE: **C. Cruz-Neira,** R. Jindal, M. Miller

LSU CS: S.S. Iyengar, N. Brener, B. Karki

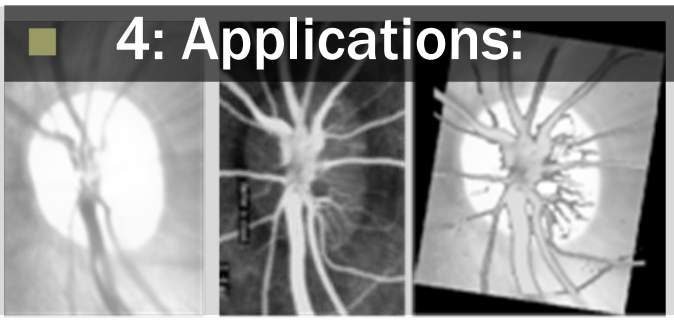
Southern: A. Jana

Review of project components

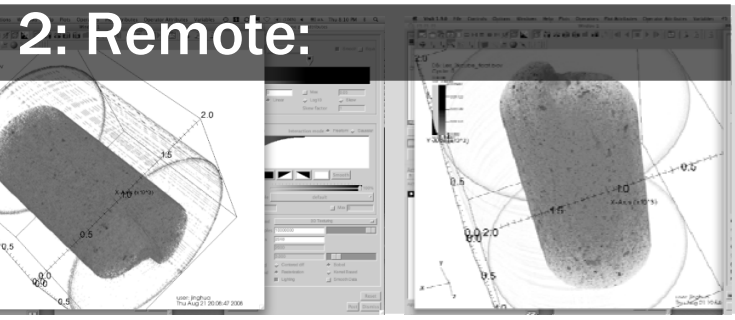
1: Data:



4: Applications:

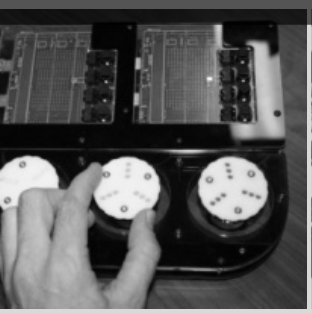


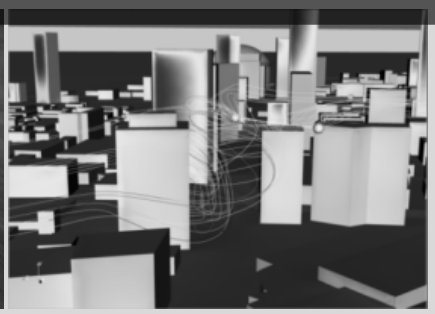
2: Remote:



Outreach:

3: Advanced:





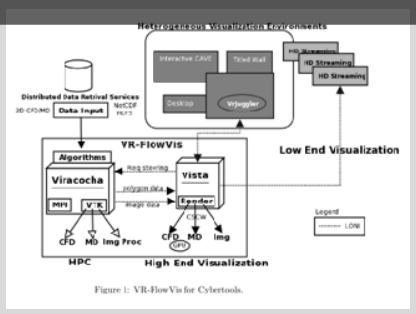


Figure 1: VR-FlowVis for Cybertools.

Review of project components

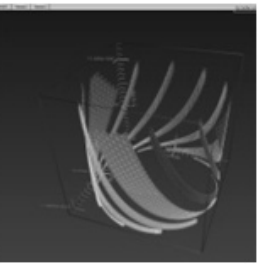
3.1: Viz/data integration: *Benger, Ritter, Jiao,* Shetty

3.2: Remote streaming: Hutanu, Ge, Amatya

3.3: Advanced viz environ.: Cruz-Neira, Ullmer, Shetty, Nates

3.4: Applications: Iyengar, Brener, Karki, *Benger*

3.5: Outreach (LIGO, Southern): Ullmer, Jana, Toole



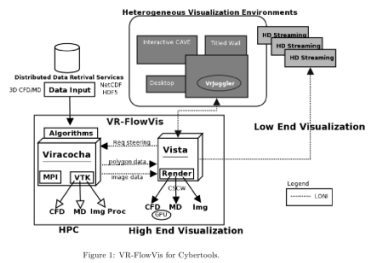
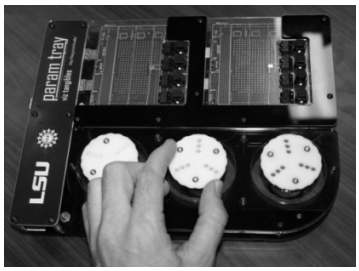
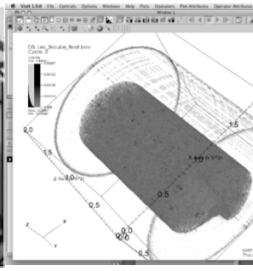
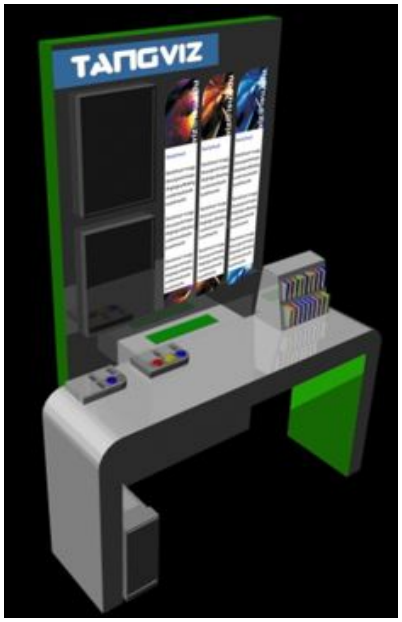


Figure 1: VR-FlowVis for Cybertools.

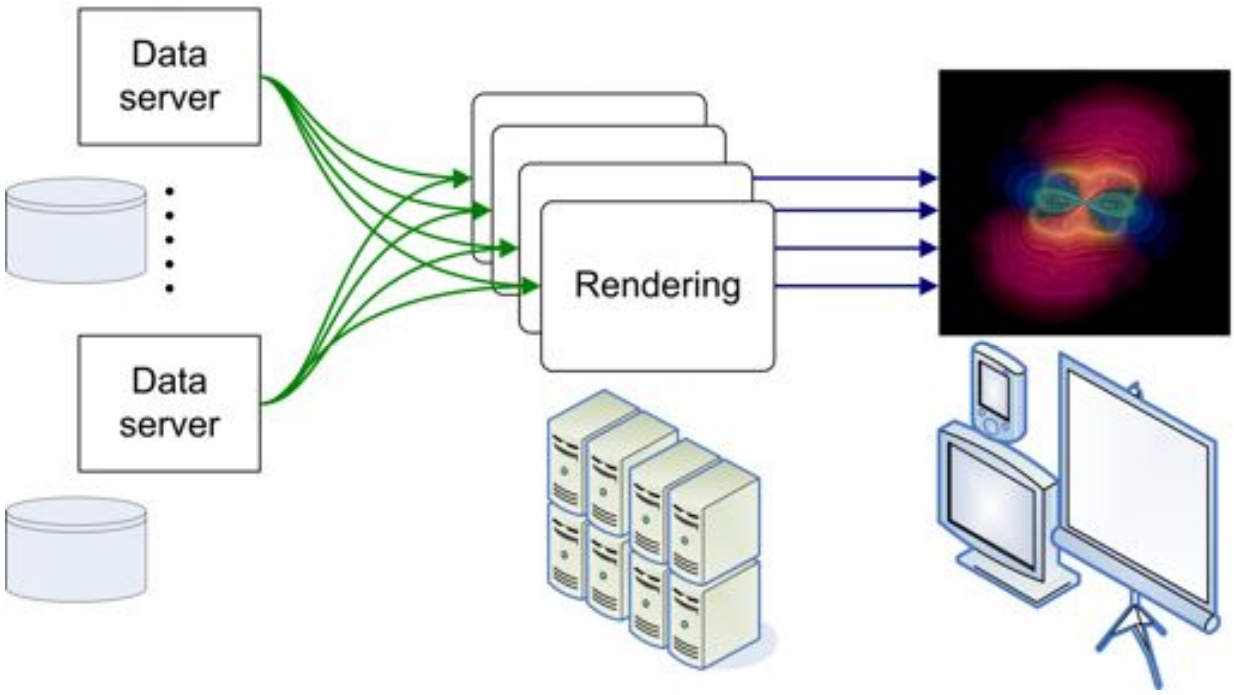




Viz tangibles + LIGO outreach update



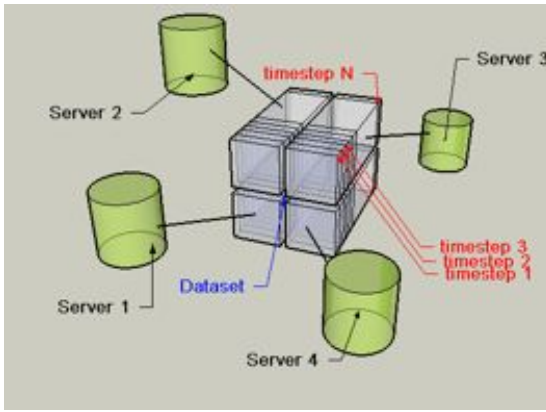
Example: remote visualization

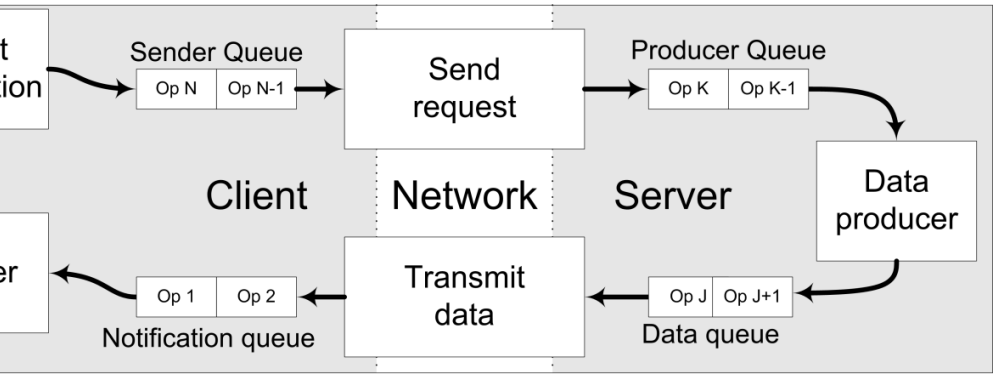


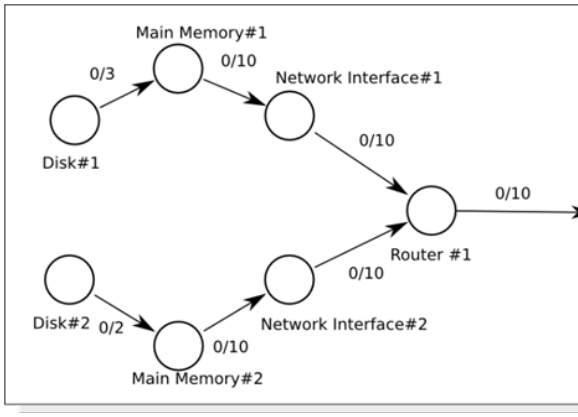
- Goal: Optimization of visualization of large data through parallelism and intelligent resource selection
- CyberTools Components: PetaShare, Visit/Equalizer/Vis VRFlowViz, SAGE/UltraGrid, Science Drivers data

Data

- Use distributed data servers
- Designed an algorithm to use information about network topology and link capacity to optimize throughput
- Flexible, pipelined high-performance data transfer system





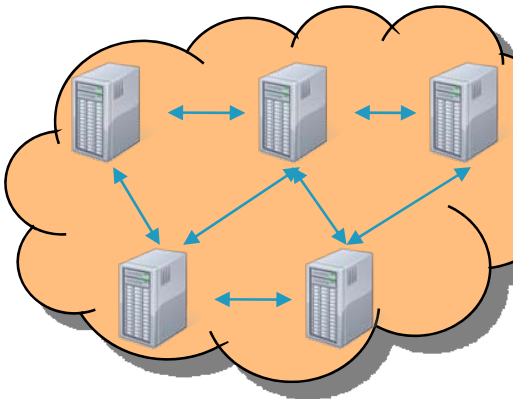


Data

- Status:
  - Data transfer system implemented
  - Optimization algorithm for prefetching and deterministic network links designed
- Next steps:
  - Tuning the data transfer system and integrat in visualization application (currently using Petashare)
  - Implement optimization algorithm and integrate in data transfer system
  - Benchmark suitable transport protocols

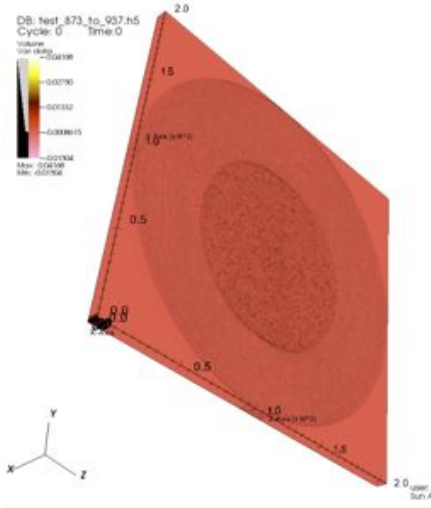
Rendering

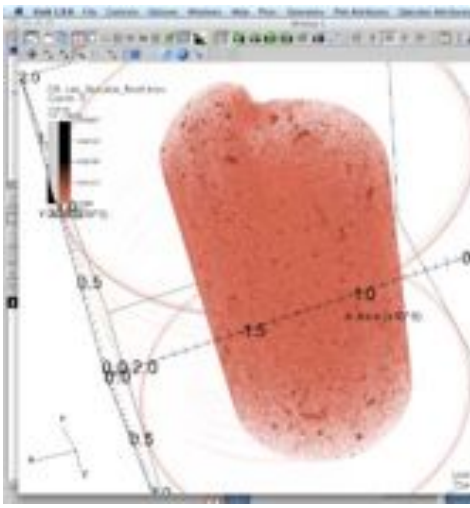
- Use HPC and visualization clusters to render large datasets
- Choose rendering options (data distribution, image distribution or hybrid) and configuration



Rendering

- Currently investigating two visualization systems: visit and Equalizer, testing with an example dataset
- Visit: complete visualization system, does not yet support hardware – accelerated parallel rendering
- Equalizer: flexible system designed for parallel rendering
- Future steps: benchmark and compare various rendering options, long-term: automatic tuning of configuration parameters





Streaming

- Transport resulting images to user
- Options: hardware-assisted, software (integrated in the application or external)
- Current status:
  - successfully used hardware-assisted system based on HD videoconferencing set-up used for HPC classes. Advantage: can be used with any visualization application, Disadvantage: poor scalability
  - Evaluating software-only rendering options (SAGE, visit & VISH built-in streaming)
- Future work: automatic tuning of video streaming parameters

ULTRAGRID

SAGE

Demos

- Data: synchrotron x-ray tomography of flame retardant in polystyrene solution. 32Gb (2048x2048x2048) for single datas
  - Simple image data set for development, will move to using more viz from CyberTools
- Demo 1: parallel software rendering (raycasting) with ViSit on HPC cluster
- Demo 2: parallel hardware-accelerated rendering (texture mapping) with equalize on two high-end visualization workstations

IMAGE FUSION

Faculty:
Dr. S. Sitharama Iyengar (LSU)
Dr. Nathan E. Brener (LSU)
Dr. Bijaya B. Karki (LSU)
Dr. Hilary Thompson (LSUHSC)

Project Coordinator: Dr. Dimple Juneja

Graduate Students:
Dr. Hua Cao
Rathika Natarajan
Harsha Bhagawaty
Asim Shrestha
Jagadish Kumar
Gaurav Khanduja
Dipesh Bhattarai

Integration with Collaborators:
Dr. Acharya
LSU Health Sciences Center (LSUHSC)

Visualization: Image Fusion

- Combining relevant information from two or mo images with different modalities into a single image. Current applications in biomedical computing, remote sensing.
- Important tool for dynamic data driven computi scenarios for automated data extraction.
- Test problem: Branching arterial images (Thompson)
  - Content change and non-uniform distributed intensities of the involved images
  - Automate to support end-to-end workflows

Image Registration:
Adaptive Exploratory Algorithm

w algorithm to identify control points for image registrati

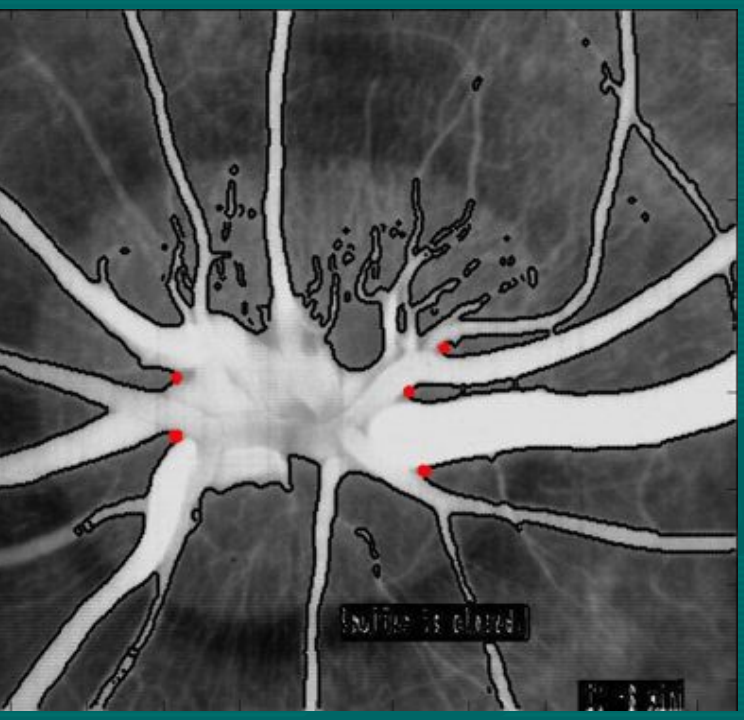
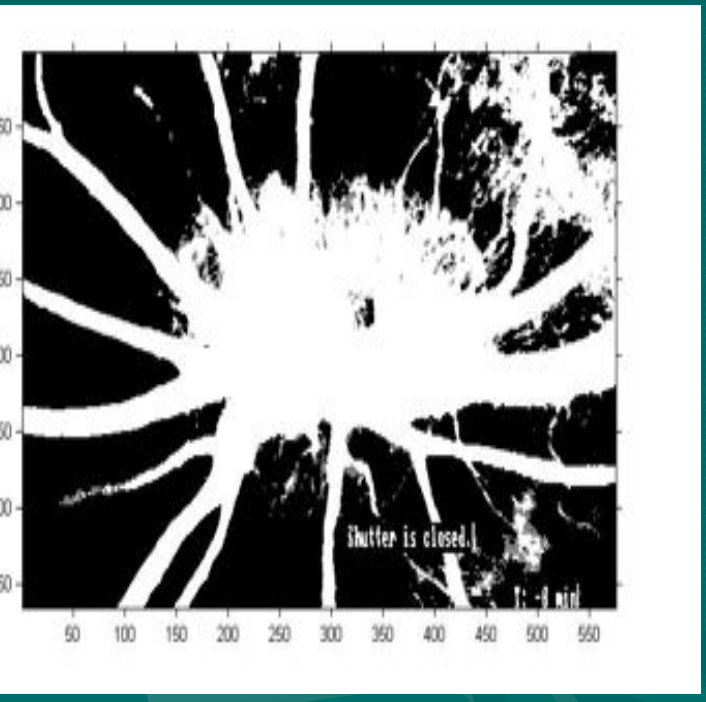


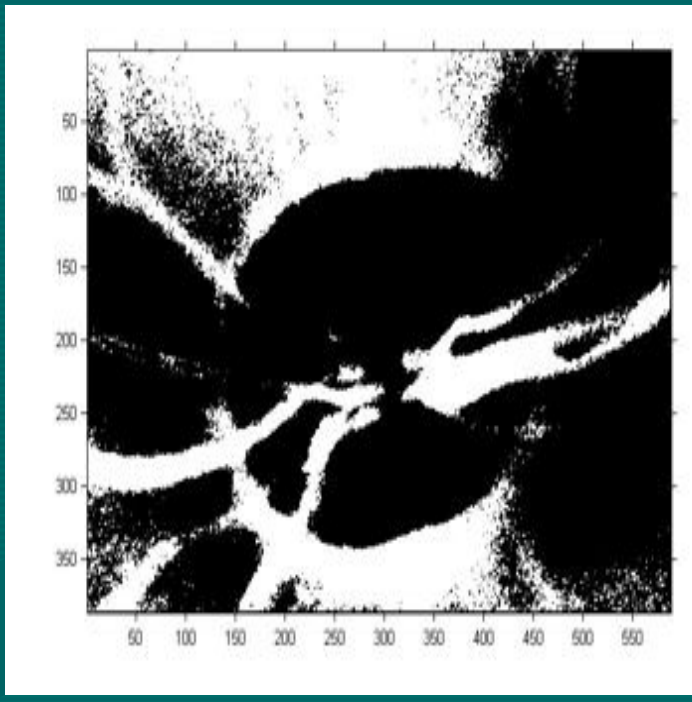
Image 1

Image 2

Image Registration:
Mutual Pixel Count Algorithm



BW image of Image 1



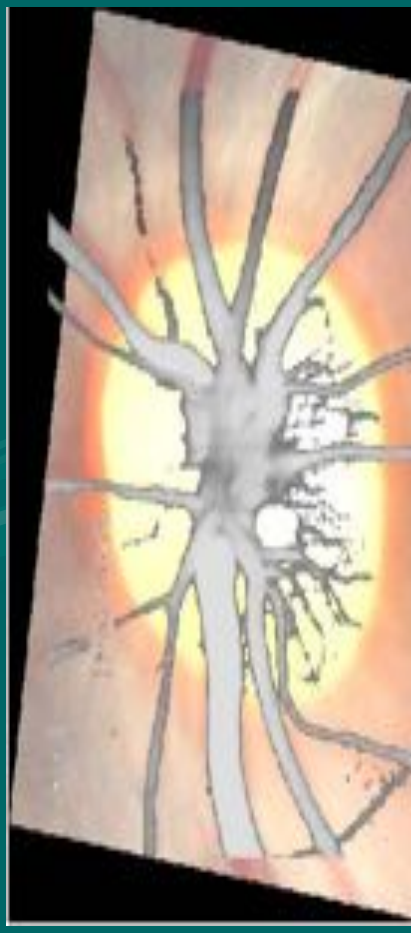
BW image of Image 2

New algorithm iteratively varies control points
to improve accuracy of registration.

Fusion of Images

A

B



C

C is the composite (fused) image of A and B.

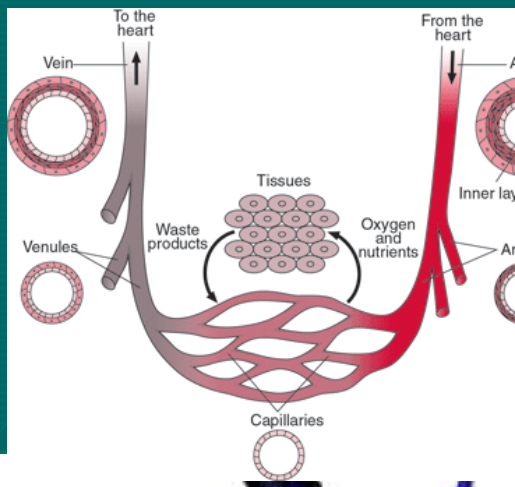
pplication of Image Fusion Techniqu to Biotransport

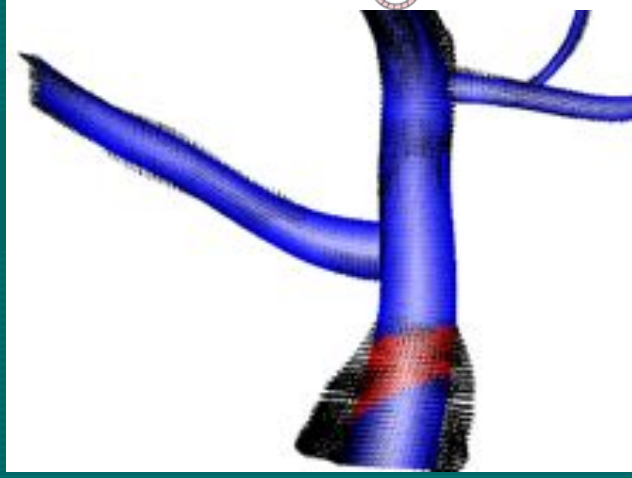
Acharya and colleagues are researching transport processes to model blood flow through arteries.

Starting point is accurate mesh for artery structure.

Our data fusion algorithms will generate fused images with more detailed geometric information than individual images leading to more accurate meshes.

Arterial Vessels





Publications

1. K. Manikandan, Debnath Pal, S. Ramakumar, Nathan E. Brener, S. Sitharama Iyengar and G Seetharaman, “Functionally Important Segments in Proteins Dissected Using Gene Ontology Geometric Clustering of Peptide Fragments”, Genome Biology, Vol. 9, Issue 3, article R52 (2008).

2. Hua Cao, Nathan Brener, S.S. Iyengar, "High performance Adaptive Fidelity Algorithms for Multi-Mod Image Fusion" , Submitted to IEEE Transactions on Computers.

Milestones

ct 2007- Jan 2008

- Designed new data fusion and data mining algorithm

an 2008- Aug 2008

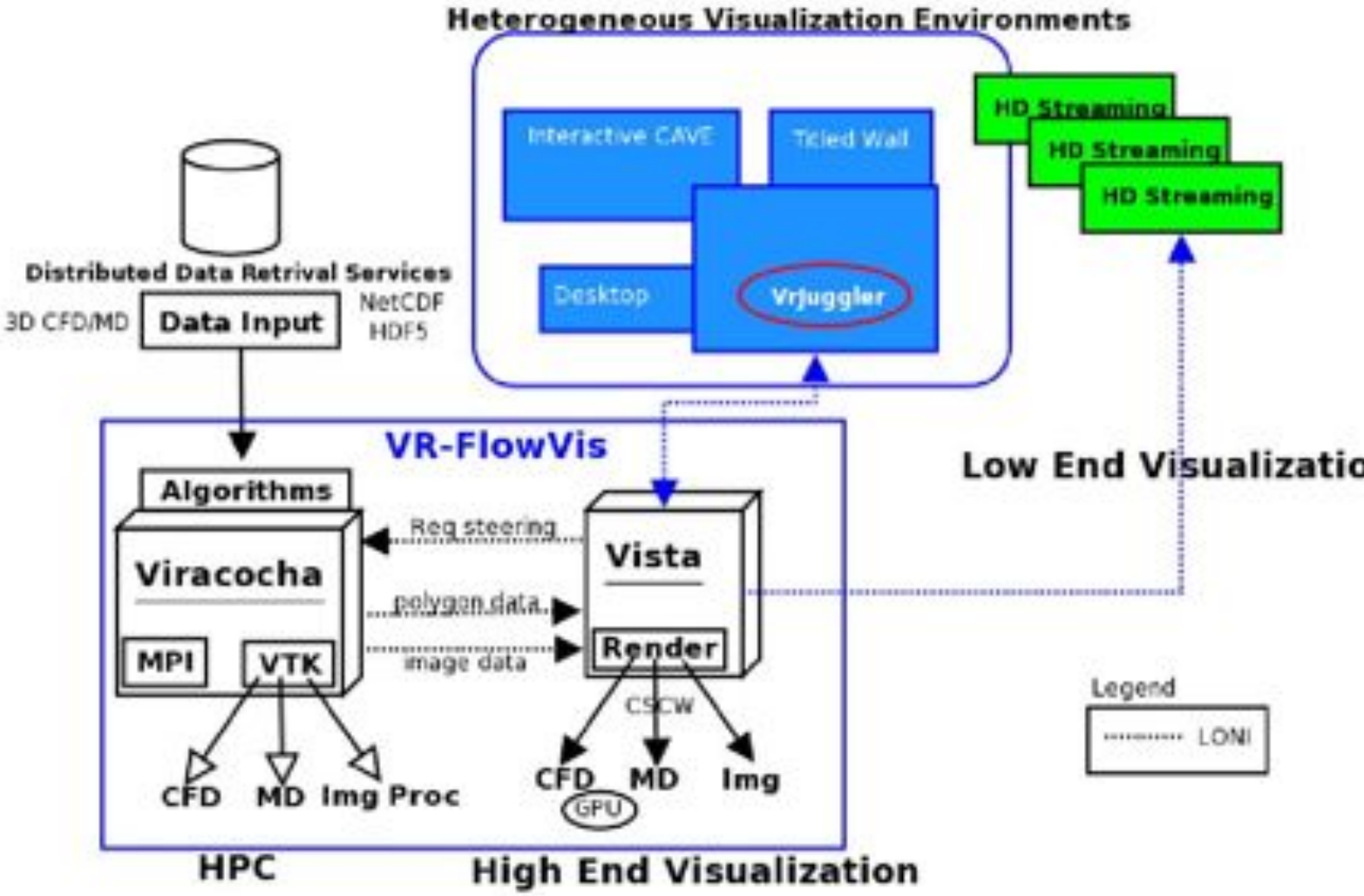
- Implemented algorithms on large scale data sets
- Developed cyber tools for data fusion and data mi applications
- Published papers and one PhD graduated and two students (Oak Ridge National Lab)

uture Work

- We will be providing software tools to be u by the science drivers

VRFlowVis

- Nikhil Shetty & Vignesh Nateshan



Education: Year 1

iverables in K-12 & Undergraduate training:

•**High School Apprenticeships:**
LaTech → Science project on glucose sensor
Tulane HSC → Preparation of apo glucose oxidase

•**Design academic year projects on topics of the grant:**
We will begin implementing it in 2008-09. A meeting is scheduled to discuss possible projects, venues for students to carry them out, supervisors, etc. One Tulane student is already on board.

•**Create summer research opportunities targeting primarily minorities:**
A 5-week program at Tulane in summer 2008 took place in June-July. There were 7 students from Tulane, Dillard, Xavier. The projects included microorganism swimming and disease transmission modelin

2008 Summer research program in Computational Science at Tulane University

Modeling epidemics and disease transmission of the West Nile Virus using continuous and discrete models with space

Justin Walbeck & Timothy Clinton (Tulane), Caira Dyer (Dillard)

Numerical models of jellyfish motion

Namdi Brandon (Tulane) and Barry Jackson (Xavier)

Modeling Microorganism Locomotion with Stokes Flow

Austin Griffith & Maren Leopold (Tulane)

Mathematical models of disease transmission

Cavin Ward-Caviness (Tulane)
senior project

Education: Year 1

iverables in Graduate training:

•**Summer Internships or extended visits to other institutions:**

This included sending Tulane students to IfM or CCT for extended visits. It also included sending students to other institutions for the summer.

•Emir Bahsi (LSU Graduate Student) visited Tulane (May 2008)

•Jerina Pillert & Kate Hamlington (Tulane Students) had virtual meetings with LSU CCT & IfM (July 2008)

•Senaka Kanakamedala (fM) visit to Tulane planned (September 200

•**Multi-institutional dissertation committees:**

Cortez is on Hamlington's committee (Gaver, BME, Tulane)
Bishop is on Henry's committee (D. Blake, Biochem, Tulane)
DeCoster is on Kanakamedala's committee (Lvov, Chem, LaTech)

Education: Year 1

eliverables in Postdoctoral training:

- **Cross Institutional mentoring and training:**

Mehnaaz Ali (Tulane), Mangilal Agarwal (LaTech IfM), Yuen Yick Kw
from Purdue will join Tulane in August 2008

Mehnaaz Ali: A Biochemistry postdoc visited IfM to learn about the facility and microfabrication techniques.

Mangilal Agarwal: An Electrical Engineering postdoc visited Tulane t
learn about biochemistry and molecular biology.

Outreach: Year 1

ublications: Including joint authorship across institutions and rticipants, general audience articles

cientific and nonscientific conference presentations:

- BMES (Oct 2008) – Kate Hamlington
- ACS (August 2008) – Diane Blake (as we speak!)
- ACS (August 2008) – Mangilal Agarwal (last Tuesday)