CIS
Center for Computation & Visualization
AN OVERVIEW
April 11, 2017

Gurcharan S. Khanna, Executive Director
WHO WE ARE & WHAT WE DO

• CCV is a hub for researchers to connect with our application scientists and leverage our computational and visualization infrastructure
Ben Knörlein, PhD, Visualization

• Ben specializes in projects using computer vision and virtual reality.
• One of his current projects is visualization of holographic images of phytoplankton collected from the 4 week research expedition aboard the R/V Falkor in the Pacific this January that can be studied in ways never before possible.
• This project is funded through a $100,000 RI STAC grant awarded to Professor Melissa Omand at URI and Co-PI Tom Sgouros at CCV.
• Gave a talk at NASA Goddard to disseminate the results of his research.
• [video]
Holographic Phytoplankton Project

Photos courtesy of Schmidt Ocean Institute

Image courtesy of CCV
Ben Knörlein, PhD, Visualization

• Ben has also been working on creating software tools to display and analyze video imagery of animals in motion using X-rays. This NSF funded project is XROMM (PI Beth Brainerd). Ben was the first author on a published paper describing the capabilities of the software program he wrote. This software is used by more than 10 labs worldwide. [video]

• He previously worked on rendering 3D landscapes of the Martian surface in a NASA funded project to determine optimal landing sites for manned spacecraft.
Peisi Yan, PhD, Biostatistics

• Peisi specializes in statistical analysis of brain imagery.
• One of her current projects is with the Brown Institute for Brain Sciences. This grant funded project is looking at ways to improve the accuracy of MRI data analysis.
• Peisi will be the second author in the soon to be published paper from this research group.
Change-of-mind Project

Study how people revise a decision before it’s fully executed. We found that changes of mind are initiated with inadequate perceptual evidence. At the time of reach initiation, changes of mind are characterized by increased response conflicts and delayed attentional shifts. These neural dynamics are then used to predict changes of mind over direct reaches over certain electrode sites only several hundred milliseconds prior to response onset.
Change-of-mind Project

Highlights:

• Data-driven methods to screen potential EEG recording signals.

• Apply statistical methods to predict change of mind prior to reach execution

• Future direction to combine EEG and fMRI
Helen Kershaw, PhD, Engineering

Helen specializes in using high performance computing in scientific data analysis. One of her current projects is for Professor Jung-Eun Lee in Brown’s Earth, Environmental, and Planetary Sciences. Professor Lee’s research is trying to answer these questions:

• How do land surfaces and plant types affect climate?
• How does the global distribution of water isotopes affect precipitation?

This work involves:
• Porting Geophysical Fluid Dynamics Laboratory (GFDL) atmospheric models to OSCAR: AM3, AM2
• Modifying the GFDL models to have tracers so the effect of water isotopes on precipitation can be studied
• Porting the National Center for Atmospheric Research coupled climate model to OSCAR
CESM slab ocean model precipitation rate

Large-scale (stable) precipitation rate (liq + ice)
Wind AM3 ~300 feet above sea level
Her role as XSEDE Campus Champion:

• Help researchers analyze the performance of their code for their allocation proposal
• Help users determine which XSEDE systems fit their needs
• Assist researches to quickly get start-up allocations on compute resources
• Provide information about national Cyberinfrastructure (CI) resources to researchers

For researchers that outgrow Oscar and need XSEDE supercomputers
Mukul Dave, MS, Engineering

Mukul is working on improving the usability and performance of OSCAR, CCV’s HPC cluster. He has a special background in using Matlab on HPC clusters. He is working on scalability issues with Matlab. His project is HPCmatlab.
Scaling Matlab to Multiple Nodes - HPCmatlab

- Matlab has limited support for parallel programming across multiple nodes
- HPCmatlab framework provides an intuitive API for making Matlab processes talk to each other by the use of Message Passing Interface (MPI)
- Matlab processes are launched in an MPI container which makes it trivial to run processes across multiple nodes
- MPI functions are wrapped in MEX functions which can be called from Matlab directly for communication
- Very good scalability observed for real applications e.g. a quantum physics application was scaled up to 630 processes on Gordon cluster at SDSC
- It can be used with Octave as easily

Scaling Matlab to Multiple Nodes - HPCmatlab

Weak scaling of quantum physics application on Gordon cluster using Octave
OSCAR, High Performance Computing

OSCAR and connected systems
8,600 cores
600 TB storage raw
56 Gigabit network
YURT, State of the Art Immersiveness

140 Million pixels
69 projectors
360 degree surface and top and bottom
Holds 8-10 people comfortably

Video-Welcome to the YURT
Video-Student interns in the YURT
YURT SCENES
A VISUALIZATION ECOSYSTEM?

YURT room based system
CAVE room based system
HTC Vive Head Mounted Display
Oculus Rift Head Mounted Display
Kinect Head Mounted Display
Workstation rendering
Laptop rendering
Mobile device rendering

Vertical Integration
Horizontal Integration
Real time
Shared
Physics
BY THE NUMBERS

https://web1.ccv.brown.edu/stats_2016
Center for Computation & Visualization
Computing & Information Services
Brown University
ccv.brown.edu
@brown_ccv

Gurcharan S. Khanna, Executive Director

John Huffman, Manager, User Services & Viz Projects
Helen Kershaw, Application Scientist
Ben Knörlein, Application Scientist

Tom Sgouros, VR Lab Manager
Peisi Yan, Application Scientist
Mukul Dave, Application Specialist