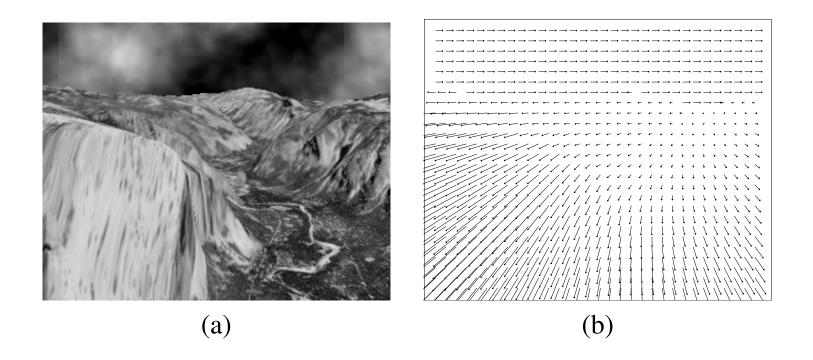# 2D/3D Optical/Range/Scene Flow, 2D/3D Tracking and Plant Growth from 3D Range Data

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Courses

- CS1027a Computer Fundamentals II: Java and Data Structures

- CS2035b - Data Analysis and Visualization (MatLab)

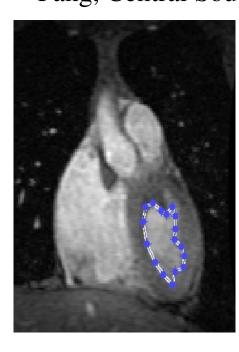- CS9630a - Image Processing and Analysis (with MatLab)
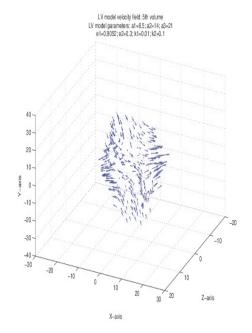
Computing Optical Flow

(a)

(b)

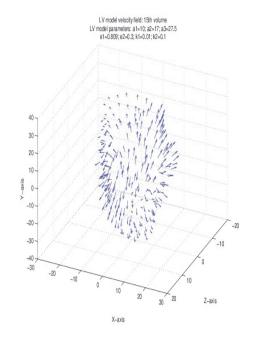(a) The middle frame from the **Yosemite Fly-Through** sequence and (b) its correct flow field.
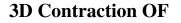
Examples of Recent/Ongoing Research

- Computing 3D Optical Flow for gated MRI data of the left ventricle of a beating human heart using a model of the left ventricle [with Prof. Huang Fang, Central South University, China]

Left Ventricle of Heart
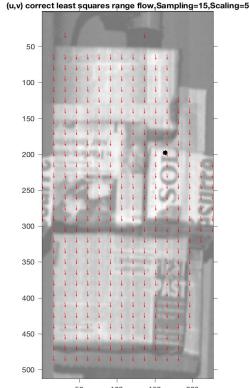
3D Contraction OF

3D Expansion OF

- Range flow (from 3D depth maps and the X, Y and t depth derivatives) to compute 3D flow on a 3D surface in a hierarchical framework (with Seereen Noorwali)
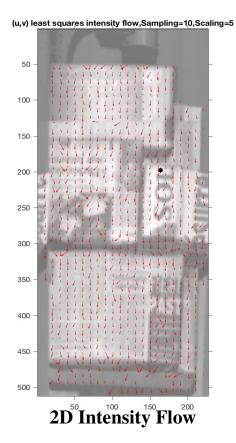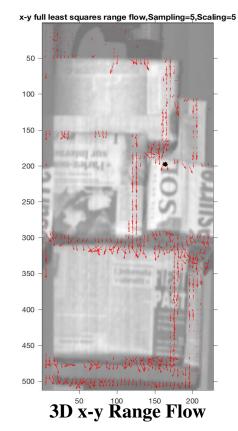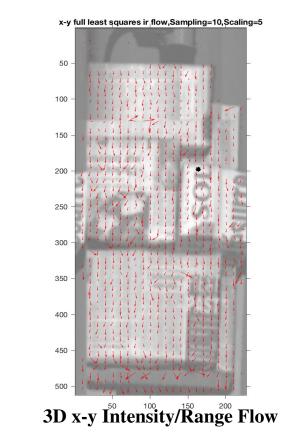

A Box Intensity Image

A Box Depth Image

Correct 3D x-y Range Flow

Some 2D Intensity (Optical) and 3D x-y Range Flows

(u,v) least squares intensity flow,Sampling=10,Scaling=5

x-y full least squares range flow,Sampling=5,Scaling=5

x-y full least squares ir flow,Sampling=10,Scaling=5

2D Intensity Flow   **3D x-y Range Flow**   **3D x-y Intensity/Range Flow**
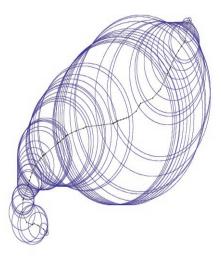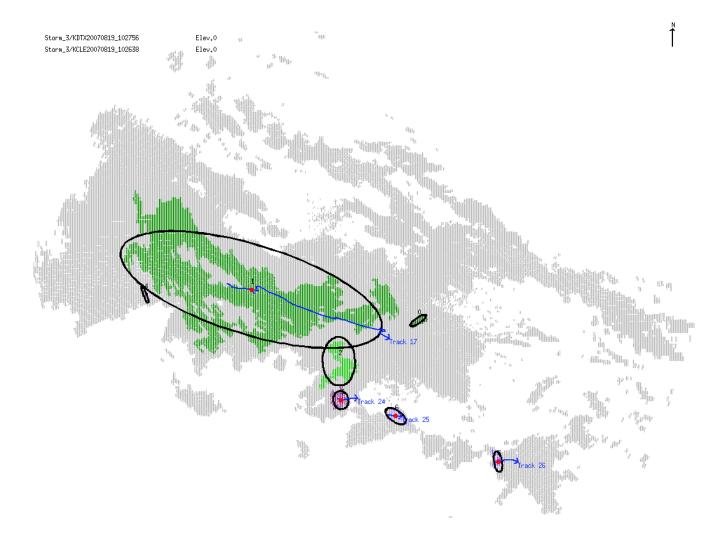
- Detecting Tornado "hook echos" in Doppler weather data, computing 3D wind velocity as 3D optical flow using dual Doppler radar and Wind-profiler data, computing long storm trajectories in Doppler weather data using 3D optical flow (with Prof. Bob Mercer, Dr. Paul Joe and Hongkai Wang, Yong Zhang and many others).

2003 Oklahoma City Hook Echo

Hook Echo Skeleton

Storm_3/KDTX20070819_102756   Elev.0
Storm_3/KCLE20070819_102638   Elev.0

N

Track 17

2

Track 24

6

Track 25

4

Track 26
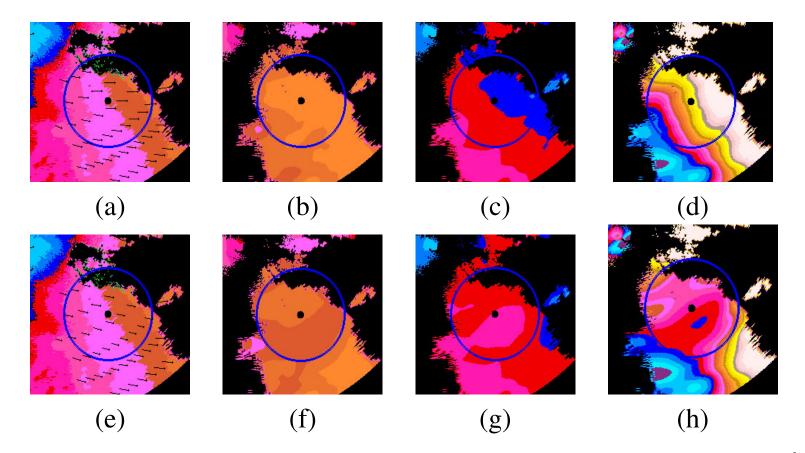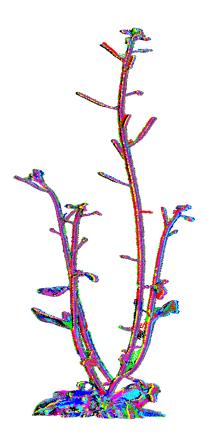
Using Pseudo Storms to Track Deforming Severe Weather Storms, Storms can Merge and/or Split

Real Data Results for partially overlapping Detroit Doppler and Harrow Windprofiler Radars

Full velocity retrieved from the Detroit Doppler (and the Harrow Windprofiler) data on August 19th, 2007 at 12:35:10: (a) the unrefined UV optical flow, (b) the U, (c) V and (d) W components of the unrefined optical flow, (e) the refined UV optical flow and (f) the U, (g) V and (h) W component of the refined optical flow.

- # Quantitative plant growth

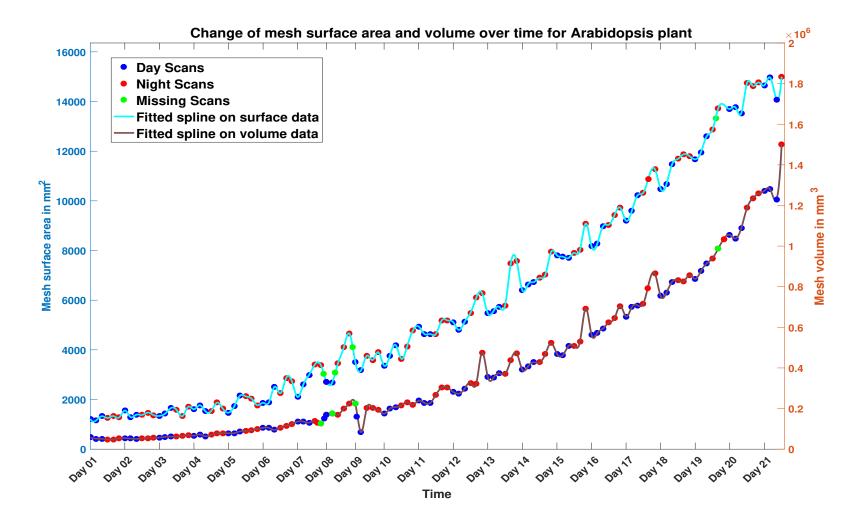Robot room where the experiment was performed

Reconstructed Arabidopsis plant point cloud (different colors indicate different scans). Note that there was no plant jittering in our setup as the wind could be fully controlled, unlike for the setup used in Brophy's work (described in Chapter 3).
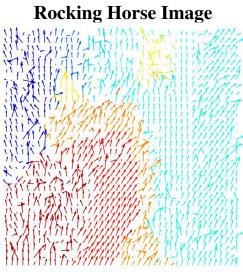
- Using 3D point clouds of multiple views of a growing plant (and the closed 3D triangular meshes computed from their registration) to non-invasively measure the 3D growth of the plant, using its 3D height/area/volume measurements and the 3D areas of its canopy and individual leaves (with Profs. Norm Hunër, Rajni Patel, Bernie Grodzinski and Ayan Chaudhury, Chen Zhao, Pu Yang, Quazi Akter).
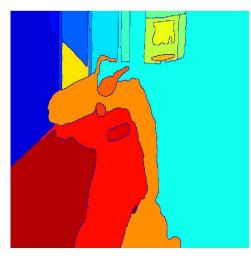
Diurnal growth pattern of mesh surface area and volume for the Arabidopsis plant. The red dots represent night time scans, the blue dots represent day time scans and the four green dots represent missing scan data. A spline is fitted to both surface and volume scan data (shown in different colours). The y-axis in the left and right hand side represents the range of surface area and volume data respectively.

- Computing 2D optical flow using segmented closed occlusion regions (with Hua Meng)
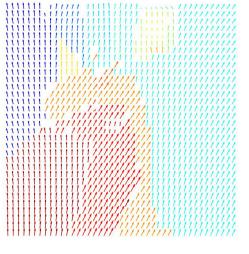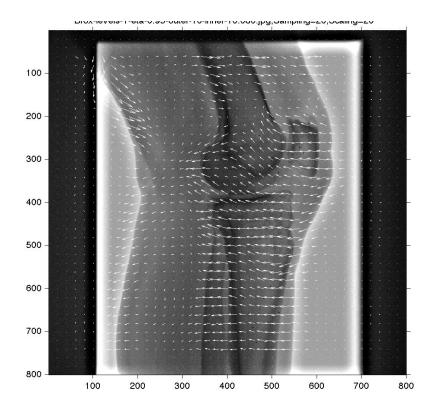

Rocking Horse Image

Coloured Region Map

2D Brox et al. OF

2D Region OF

- Computing motion and structure from optical flow in a sequence of x-ray images of a bending knee event (with Yves Pritchard, Matthew Podolak).

2D Optical Flow on image 80 in a fluoroscopic image video of a bending knee.