The Telluride Neuromorphic Workshop 2011: Our Experience

Ching L. Teo (and everyone in Yiannis' Group)

Welcome to CVSS!
What is this talk about?

- The 2011 Neuromorphic Workshop @ Telluride, CO
- Challenges, modules, results
- Get you interested in our group's research:
  - Robotics
  - Computer Vision
  - Language
- Demos (?): AVW 4470
The Neuromorphic Workshop

- NSF funded for 19 years – going to its 20\textsuperscript{th} year
- Various universities: Stanford, UCB, UCLA, UCSD, ETHZ, JHU, UMD
- Neuromorphic: re-creating biological processes on chips.
  - Stanford – NN on a chip
  - ETHZ/JHU – Retina/Cochlea on a chip
  - UMD – .... Robot
- Essentially a workshop where you 'work' for 3 weeks...
So where is Telluride?

Altitude: 9500ft
Pop: 2800
Workshop
Visual Executive (VE): visual processing

Language Executive (LE): language (knowledge base)
Some Realizations of VE-LE

- Active Scene Recognition (ICCV 2011)
  - VE: extracts features, detect objects
  - LE: guides selection of next object, update scene prediction

- Sentence Generation (EMNLP 2011)
  - VE: detects objects, detect scenes
  - LE: predicts actions (verbs) and prepositions, select optimal nouns-verbs-preposition-scenes.

- Action-Tool prediction (ICRA 2012)
  - VE: detects objects, extract action features
  - LE: predicts action labels, update clusters
Telluride Task: Kitchen Activities

- First realization of VE-LE on robot
  - VE: <tool, object, action> detection
  - LE: Language Reasoner determines plausibility, suggests possible alternatives

- Erratic Robot
  - Running ROS (robot operating system)
Main Modules

- **Input:** Kinect RGB-Depth Video
- **Output:** Verbalization of activity
- **Key modules:**
  - Kinect pre-processing
  - Action/Object recognition
  - Language Reasoner
A person is using ladle to pour water into the bowl.
Some Details

- Selecting Fixation Points: Image-Torque
- Segmentation: Fixation Segmentation
- Action: Human Detection + Pose Fitting
- Recognition: Features + Attributes, DT, Visual Filters.
- Language Reasoner: Semantic Network of 'concepts' – from WordNet, FrameNet etc...
Challenges

- **Hardware:**
  - Robot short-circuited multiple times – many parts need to be ordered in advance.
  - Many sensors: Laser, Kinect, PTU, Base, Cameras – power load must be allocated correctly (fuses...)

- **Software:**
  - ROS drivers needed for hardware interface
  - Interface with Kinect not perfect (OpenNI != ROS...)
  - Some codes run on Matlab, ROS interface with Matlab not officially supported
  - Many modules was developed over 3 weeks (!)
Looking Forward

- **New Hardware:**
  - Pioneer 3 robot base. Better motor control, and more stable hardware.
  - Event-Based Camera
  - TOF camera (Swissranger)
  - 3D Laser (?)

- **Software:**
  - Robot logic needs to be refined – when to start? When to stop?
  - Movement changes everything
  - Language capabilities