AAAI Fellowship Application

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Brown University, 2014

1 Introduction

State of the art techniques in object detection and pose estimation are powerful and general but usually run at a rate less than 1 Hz. Such a slow rate makes it difficult to employ such techniques in real-time human-computer interaction.

Pitch the grocery video.

Our overall pipeline can be described as:

1. Collect RGB-D data for objects.
2. (Automatically) Train BoW model and kNN classifiers for objects.
3. Use the classifiers and additional logic to provide 3D detections pose estimates of objects.

Related work.

2 Coordinating AI with Computer Vision

MDPs, OO-MDPs, and POMDBs. How to create a perceptual system that plays well with planning.

3 Teaching the System

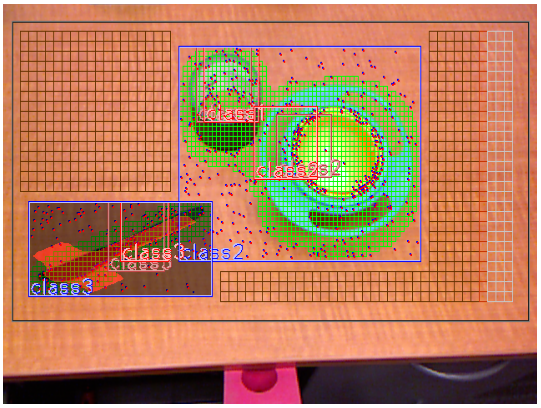
We call this process teaching and not training because it is an interaction used to collect data not a program used to optimize a function.

Semi-Automatic Teaching

1. Repeat k times:
   (a) A human operator places the object in a robot's manipulator.
   (b) The operator provides a base pose for the given grasp.
   (c) The robot collects views of many different precisely known poses, together with models for self and background filtering.

Where k might be around 3.

Currently we train the system without a robot by manually adjusting the pose of the object and manually annotating grasps. Eventually we would like to have fully automatic training, where the robot grabs objects and coordinates base poses itself.



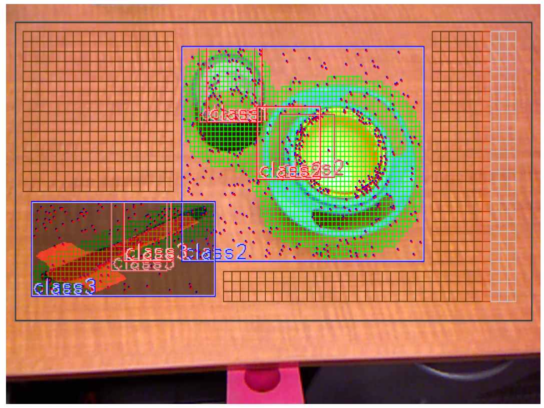


Figure 3.1: Teaching a robot to identify and manipulate objects can be as easy as bringing home a bag of groceries.

4 Work Forecast

Existing Software Manual training, robust pose estimation under good conditions. Objectness Fast Keypoints SIFT descriptors KMeans BoW Color Histogram Depth Histogram kNN MDP

Green Boxes Blue Boxes Red Boxes

Current Directions Semi-automatic training Automatic training More geometric work

Broader Impact and Future Work working MDP's into the red box exploration and data collection so that we can interact with large scale planners for tasks.

5 Attendance Statement

I have been paying attention to AI, Machine Learning, and Computer Vision since 2004. Regarding Computer Vision, I saw the progress of Neural Nets in the 90's swept under the rug by SIFT, HoG, and SVMs in the mid 2000's, only for neural nets to reclaim the throne in the 2010's. At one time it was said that AI was "vision hard" and that solving Vision would effectively solve AI. While that belief sweeps a bit under the rug, it is certainly true that in the past Computer Vision has been a strong bottleneck in the development of AI and Robotics.

Recent advances in object detection on large data sets suggest that we are ready to move beyond attacking vision in an isolated setting and begin integrating it in a larger framework for planning in an interactive environment. I have training in state of the art Computer Vision techniques and have been tracking the literature for a few years now.

Work in Computer Vision has largely centered around hyperspecific problems concerning single images. This focus has resulted in significant progress on such tasks, but the challenges of engineering real time systems has so far prevented interesting real world applications or substantial spread of techniques to other communities.

Two things have resulted from this dam in the flow of information. First, there are now many techniques in Computer Vision which are suited to fast and effective partial solutions of problems such as object detection but have been ignored in favor of much slower but slightly more effective state of the art approaches. Second, such techniques may be combined with the information available from extra sensors and the ability of real time systems to capture additional images of the same scene to form full solutions to multiple related problems (such as detection, segmentation, and pose estimation).

I have seen already that combining elements of probabilistic planning and reasoning can boost the performance of traditional Computer Vision and Machine Learning algorithms. I want to continue this approach to research, and attending AAAI will help me to fill in gaps in my background that are necessary to carve out a career in multi-disciplinary AI. Planning and Markov Decision Processes are key elements that I want to master. Additionally, I would like to explore topics such as Interactive Entertainment, Scheduling, Knowledge Representation and Reasoning, and Reasoning Under Uncertainty in order to further my understanding of Human-AI Interactions.

Finally, by attending AAAI I will be able to better understand the motivations, needs, and desires of AI and Robotics concentrators with regards to Computer Vision, which will enable me to complete my dissertation in a way that aligns with these communities' values.

6 Curriculum Vitae

Education

BS in Math, Florida State University, 2003-2006
MA in Math, UC Berkeley, 2006-2008
PhD program in Computer Science at U Chicago, 2010-2011
PhD program in Computer Science at Brown University, 2011-Present

Employment

Developer Support Engineer, Havok, 2008-2009

Conference Papers

S. Naderi Parizi, J. Oberlin, P. Felzenszwalb.
Reconfigurable Models for Scene Recognition.
IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2012

P. Felzenszwalb, J. Oberlin.
Multiscale Fields of Patterns.
To Appear, 2014

Conferences Attended

CVPR 2011
CVPR 2012

Teaching Experience

Being a TA in the UCB Math Deparment can be close to a full time teaching position, including quiz design, office hours, and grading in addition to the intense recitation sections (which more closely resembled lectures).

Calculus 1 TA
UC Berkeley, 2006-2007
Two sections in the Fall, three sections in the Spring, 30 students in each section, each section met with me two or three times a week for a total of about three hours a week.

Linear Algebra and ODE TA
UC Berkeley, 2007-2008
Same configuration as calculus.

Algorithms Grad TA
Brown University, 2012-Present

I am currently the Grad TA for the Algorithms class at Brown for the fourth semester. During this time the class has been between 45 and 100 students each iteration. I have been responsible for administering oral exams, holding office hours, lots of grading (most of our problems are proof based), and managing a group of at least 6 Undergraduate TA's each semester.

Departmental Service

Graduate Student Orientation Leader
Brown CS Department, Fall 2012

Computer Vision Reading Group Coordinator
Brown CS Department, 2012

Department Tea Organizer
Brown CS Department, 2012-Present

Misc Research

Master's Thesis in Mathematics
UC Berkeley, Written 2006-2008

Research Experience for Undergraduates in Mathematics
Oregon State University, Summer 2005

Undergraduate Research Program in Physics
Florida State University, Summer 2004

Research Assistant in Molecular Biology
Florida State University, Summer 2003

Hobbies

Gardening
Ballroom Dance
Martial Arts
Blacksmithing
3D Printing

7 Letter From Supervisor