cRops BGU Main Researchers

WP2 detection tasks: Ohad Ben Shahar

WP4: Yael Edan

Tasks T4.3, T3.7: Sigal Berman

WP9 & T3.7: Amir Shapiro
Efi Vitzrabin

- **Research Thesis** *(Ph.D.@IEM)*
  Adaptive sensor fusion with active perception

- **cRops tasks**
  - T4.1 – adaptive sensor fusion algorithms
  - ROS module for ASF

Deliverables: D4.1, D4.2, D4.3, D4.13, D4.14

ROS Modules: “Adaptive sensor fusion”
Efi Vitzrabin

Publications related to project:

1. ICR – “Apple detection using multi-dimensional adaptive thresholding with multi-resolution windows”

2. Pattern Recognition submitted – “Dynamic local 3D thresholding for robust detection in variable lighting conditions”

3. Israel Agricultural Conference 2013 – “Integration of a Robotic Harvester System Module”
Efi Vitzrabin

- 2008: B.Sc. Electrical and Electronic Engineering
- 2006-2010: Israel Aerospace Industries (Systems Engineer)
- 2011: M.Sc. Industrial Engineering

Thesis: Vegetation classification using hyperspectral sensing

Research interests:
- Robotics
- Vision
- Sensor fusion
- Systems Engineering

Main tasks in cRops:
- BGU project manager
- BGU PhD student
- Thesis: Adaptive sensor fusion
Danny Eizicovits
Ben-Gurion University of the Negev

Grasp Pose Synthesis
Danny Eizicovits

- **Research Thesis** *(Ph.D. @ IEM)*
  Grasp pose synthesis

- **cRops tasks**
  - T4.3 – Learning in grasping
  - Human Grasp analysis
  - ROS module for ASF

Deliverables: D4.6,D4.7 , D4.11

ROS Modules: “Grasp_planning”, “selectFruitState”

previously named as:
“Grasp_Affordance” and “pickOrderState”.

---

Ben-Gurion University of the Negev  CROPbS
Publications related to project:

1. SYROCO 2012 – “Discrete fuzzy grasp affordance for robotic manipulators”.

2. CIGR 2012 – “Grasp Affordance for Robotic Selective Harvesting based on Human Demonstrations”. Second author

3. Israel Agricultural Conference 2013 – “Integration of a Robotic Harvester System Module”

4. ICR 2013 – “Constructing successful grasps based on Graspability maps”.
Danny Eizicovits

- 2008: B.Sc. in Electrical and Electronic Engineering
  Thesis: Examination of constrained motion control on a hemispherical surface
- 2011-2014: M.Sc. Industrial Engineering
  Thesis: Grasp pose synthesis

Research interests:
- Robotics
- Grasp synthesis
- Learning
- Systems Engineering

Main tasks in cRops:
- Grasp affordance and human field experiments
- BGU PhD student
- Grasp pose synthesis
Roi Reshef

- 2011-2012: Business Intelligence Developer, Intel.
- 2012-2014: M.Sc Industrial Eng. & Management

Thesis: Path planning for fruit harvesting robotic arm

Research interests:
- Robotics
- Path Planning
- Search Algorithms

Main tasks in cRops:
- BGU MSc student
Path planning for fruit harvesting robotic arm
Anat Hershkovitz Cohen
Ben-Gurion University of the Negev

Path Planning
Anat Hershkovitz Cohen

Publications related to project:

ICR – “Path Planning of Manipulator for Harvesting using DMP”
Anat Hershkovitz Cohen

- 2013: B.Sc. Industrial Engineering
- M.Sc. Student for Industrial Engineering

Research: Motion planning for robotic manipulator for harvesting.

Research interests:
- Robotics
- Motion planning
- Learning from Demonstration
- DMP

Main tasks in cRops
- BGU M.Sc. Student
Alon Ohev - Zion
Ben-Gurion University of the Negev

Grasping of Deformable Objects

CROPS “Clever Robots for Crops”
Research Objectives: Development of an optimal grasp synthesis tool. Meaning, define the locations of a given number of contact points that provide:

- A stable grasp while applying minimal grasping force
- A robust grasp with respect to an external load

The synthesis results, could define a gripper design objectives

cRops tasks: T3.7-2: Grasp Planner decides how to best grasp a given fruit.
Accomplishments:

- Studying the appropriate **contact model** [Elata 96]
  - Non–liner compliance
  - Plasticity
  - Spatial

- Constructing a spatial compliant **grasp model**

\[
M(q)\ddot{q} + C(q, \dot{q})\dot{q} = \sum_{i=1}^{k} G_i(q) F_i(q, \dot{q})
\]
Accomplishments:

- Defining grasp’s quality criteria
  - The magnitude of the contact wrenches, using
    - $L_2$ Norm
    - $L_{\infty}$ Norm
  - Stiffness-Based Quality Measure for Compliant Grasps and Fixtures [Lin 2010]

- Surveying different grasp search approach:
  - Discrete exhaustive search – currently the preferred method
  - Heuristic/metaheuristics: linear relaxation, simulated annealing – not considered
Accomplishments:

- **Development of Simulation environment** that
  - Simulate dynamic behavior of arbitrary object and gripper
  - Is flexible in its gripper controller
  - Is flexible in its implementation of a different contact models
  - Presents a grasp *null space*
Accomplishments:

- **Experimental systems**
  - Construction of an experimental grasp system. Its aim is to validate the grasp’s stability and robustness analysis.
  - Initiate a second experimental system, that will measure and validate:
    - Material properties: $G, \nu$
    - Contact model
    - Coefficient of friction
Efrat Taig
Ben-Gurion University of the Negev

Visual Servoing

CROpbs
“Clever Robots for Crops”
Efrat Taig

- 2008: B.Sc in Mathematics
- 2011: M.Sc. in Engineering
- Currently : Ph.D. in Computer Vision

Research Thesis (Ph.D)

Image Composition Using Image Deformation

cRops tasks

Visual Servoing : currently looking for the fruit’s orientation.
Fruit model
Manual Threshold 0.5

RGB Normalization

RG Normalization
Manual Threshold 0.7

RGB Normalization

RG Normalization
Otsu Automatic Threshold

RGB Normalization

RG Normalization
Spatial Orientation

The diagram illustrates the spatial orientation of points in a 3D space, represented by the coordinates $(x, y, z)$. The arrows between the points indicate the direction and relative positions in space.
Ehud Barnea

- **Research Thesis** *(M.Sc.@CS)*
  RGB-D Object Detection from Partial Pose Estimation of Symmetric Objects

- **cRops tasks:**
  Deliverables: D2.3, D2.4
  ROS Modules: “Fruit Detection”
Publications related to project:

1. IJCVR – “Computer vision for fruit harvesting robots--state of the art and challenges ahead”
2. CVPR submitted – “Depth Based Object Detection from Partial Pose Estimation of Symmetric Objects”
Ehud Barnea

- 2011: B.Sc. Computer Science
- 2013: M.Sc. Computer Science

Thesis: RGB-D Object Detection from Partial Pose Estimation of Symmetric Objects

Research interests:
- Computer Vision
- Robotics
- Object Detection

Main tasks in cRops:
- BGU PhD student
- Thesis: Task-Based Camera Design
Boaz Arad
Ben-Gurion University of the Negev

Hyperspectral Reconstruction
Single point TOF/RGB Registration

CROPS
“Clever Robots for Crops”
Boaz Arad

- **Research Thesis (M.Sc.)**
  - Hyperspectral Reconstruction from RGB

- **cRops tasks**
  - Research applications for hyperspectral reconstruction
  - Fast single point TOF/RGB registration
  - Texture/color based detection of green peppers
Dictionary based method allows for high accuracy reconstruction of spectra from RGB data.

Collected high-resolution HS data from local pepper greenhouses.

Green peppers and surrounding foliage produce highly similar spectral signatures.
Boaz Arad - TOF/RBG registration

- Whole image registration may be poor/non-existent and computationally expensive.
- Registration of center point may suffice for visual servoing.
- Center point depth data may be computed by solving a single linear equation.
Peppers are smooth, leaves are not.

Exploit smoothness in texture and color to detect green peppers.

Promising results, spectral highlights cause difficulty.