Exploring computer vision frontiers with MATLAB

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Compac Technologies
Company overview

- **Global leader** in development, manufacture & supply of smart produce handling systems
- Reputation for **innovation** and leading edge technology
- Established in **1984** by Hamish Kennedy
- Now a global company, **400+** staff
Compac solutions

From single lane sorters to fully integrated turnkeys

1 lane: 2.5 – 4 ton/hour

10 lanes: 30-50 ton/hour

40 lanes: 100-160 ton/hour
Industry leading R&D

• R&D comprises approximately 20% of overall Compac staff with a total of 72 employees

• 20% Government funding for the next 5 years through the Callaghan Innovation R&D Growth Grant

• Department is expected to grow by 50% in the next 5 years and continue growing

• Vision Team mix of software / algorithm developers, test engineers, mechanical designers and technicians
Compac vision system

- Automated inspection system
- Real-time image processing
  - Up to 12 fruit per second, per lane
  - 70 images per fruit
  - Multiple cameras & wavebands
  - 100% fruit surface coverage
- Powerful grading capabilities
  - Size, shape
  - Colour, texture
  - Surface blemishes
How we use MATLAB

• Understanding our product!

• Algorithm development
  – Blemish grading
  – 3D reconstruction

• Data analysis / visualisation
  – Fruit classification tool

• Prototyping
  – Automatic camera calibration

• Rapid tool development
  – Mirror bend test
Understanding our product

- Our vision software is... complicated
  - Real-time, complex system
  - Coded in C++
  - 2 decades of development
  - Numerous developers
  - Lots of legacy code
  - Complex architectures
Understanding our product

- MATLAB is enabling us to ‘pull-apart’ our software and analyse / improve individual components
  - Many parts of the vision processing chain have now been replicated in MATLAB
  - Able to process offline (using recorded data), find issues / limitations, and create new solutions
  - Much quicker and more flexible than trying to work in C++ directly
Testing mirror flatness

- **Problem:**
  - Develop production tool for checking mirrors for distortion

- **Solution:**
  - GUI for loading images, processing & displaying results
  - Compiled as executable
  - Project completed in 4 hours!
Reasons for using MATLAB

- Industry standard
- Fast learning curve
- Rapid results
- Powerful toolboxes
- Community support
  - File Exchange
- Regularly updated
  - 2 releases / year

Useful MATLAB toolboxes for computer vision:
- Image Processing
- Computer Vision System
- Image Acquisition
- Wavelet
- Statistics
- Neural Network
- Optimization
- Parallel Computing
MATLAB File Exchange

- Great online resource
- Free downloads
- User rated submissions
Interfacing with C/C++

- Quick and easy to compile DLLs and call from MATLAB
- Useful for unit testing code modules
- Allows incremental / modular progression of prototypes from MATLAB to C/C++
MATLAB Compiler

• Very easy to use

• Generates deployable executables
  – No license restrictions

• Some limitations
  – Requires MCR library installation
  – Slow to initialize (10 seconds)

• Fantastic for rapidly deploying standalone R&D tools
Conclusions

• MATLAB is enabling Compac to accelerate its R&D programme
  – Rapid algorithm development
  – Data analysis / visualisation
  – Rapid prototyping
  – Application development

• Now our standard tool for computer vision research