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EO Processing Design Using GEDAE

Dave Humphreys
Graeme Harvey
Mark Daniell

BAE SYSTEMS Avionics,
Sensor Systems Division

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  - –Cuer
  - –Tracker
- Conclusions
- Future Work
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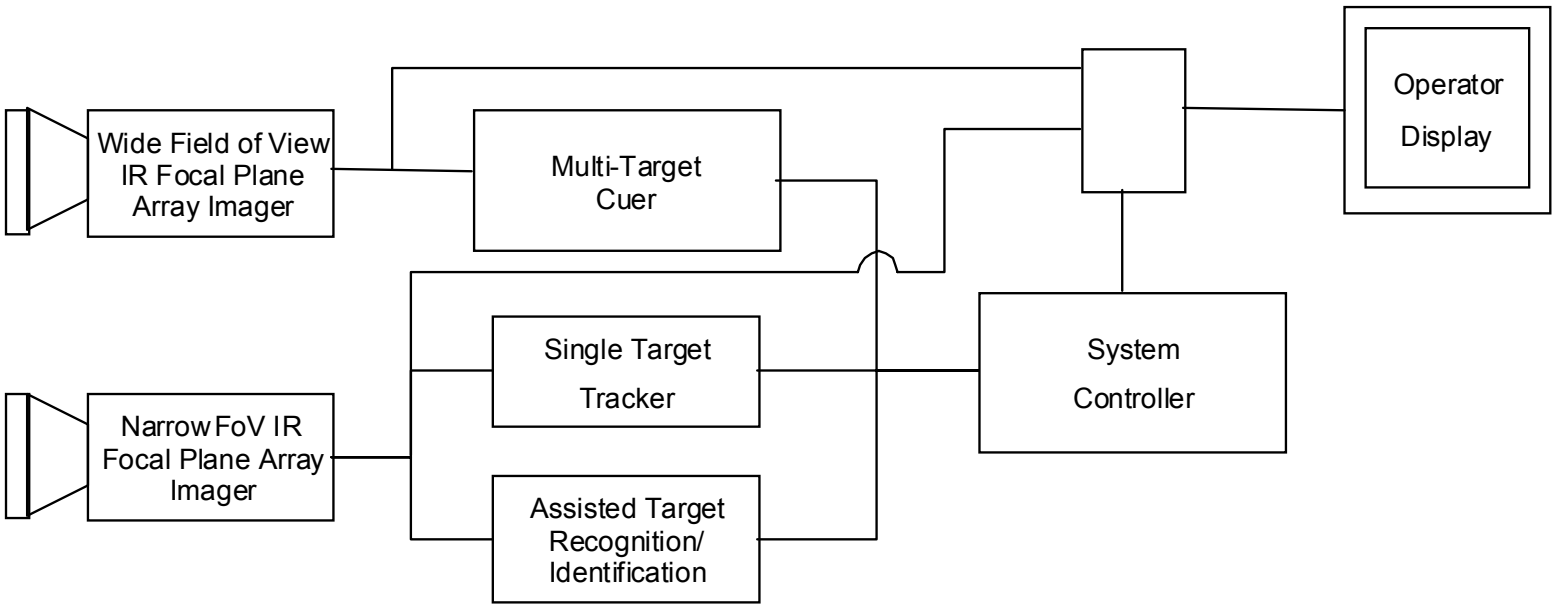
EO System Block Diagram



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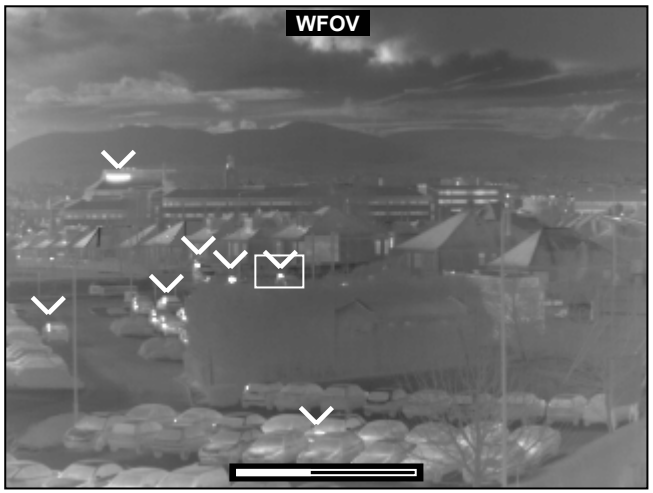
Cuer & Tracker Output



Cuer

- Detects & tracks multiple targets
- Cues high-priority tracks

Single Target Tracker

- Track single target of interest
- Centroid tracking

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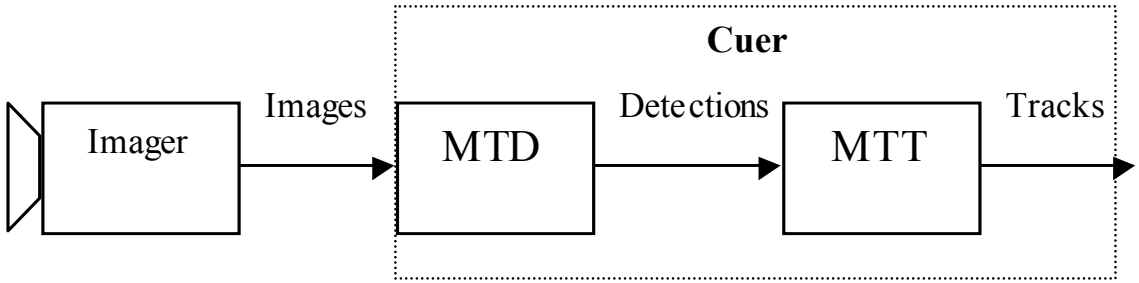
Cuer Structure



- Image sequence from imaging sensor
- Multi-Target Detection (MTD) detects objects in image
- Multi-Target Tracker (MTT) forms temporal track files from detections and highlights high priority tracks as cues.

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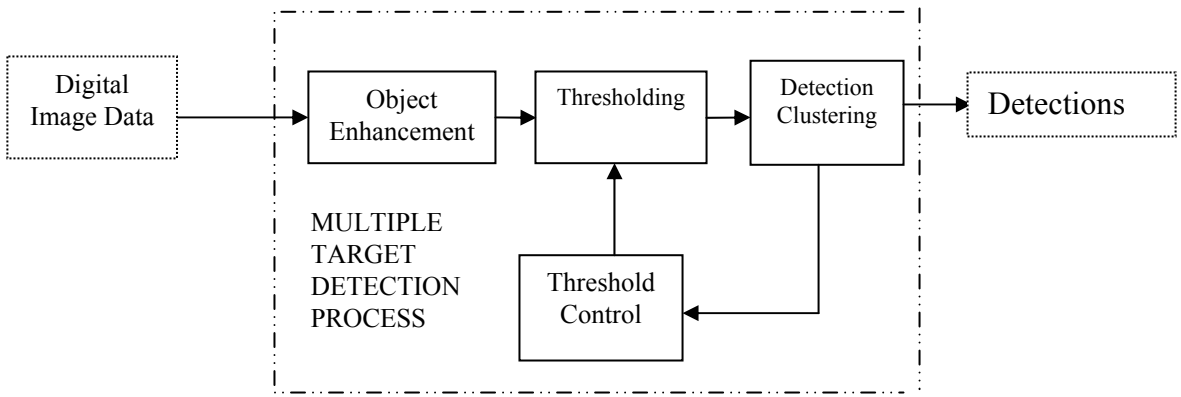
MTD Algorithm



The MTD algorithm is made up of a mixture of image, signal and data processing functions, namely:

- Object Enhancement
- Thresholding
- Detection Clustering
- Threshold Control

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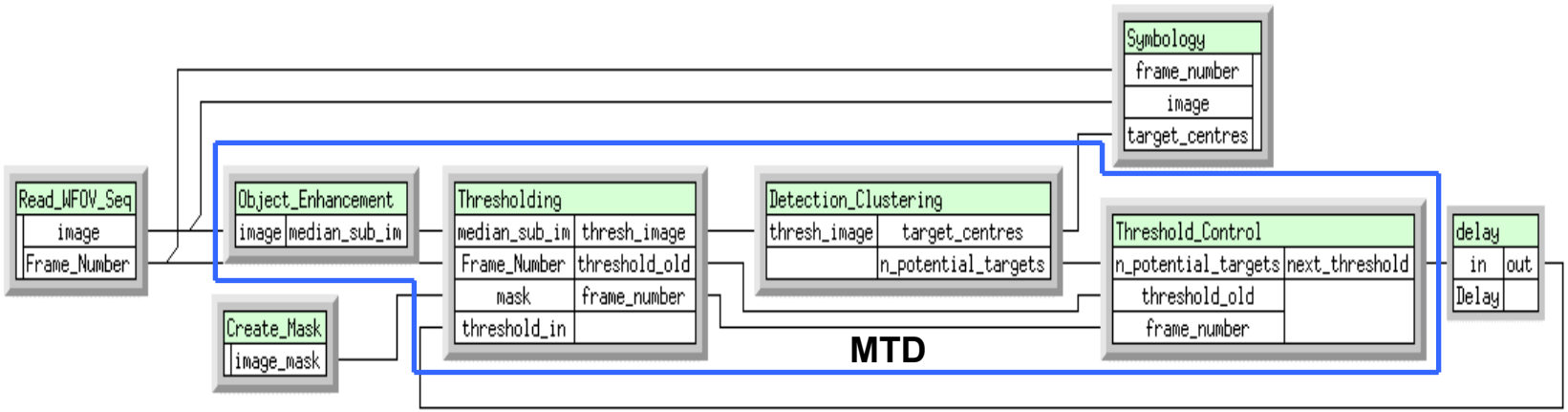
MTD Flow Graph



- The main functions of the MTD algorithm are enclosed by the blue line
- The other functions shown support the MTD algorithm, allowing it to be operated as a stand alone function.

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MTD Preliminary Performance Figures

Function	Execution Time (ms)
Object Enhancement	331
Thresholding	29
Threshold Control	<1
Detection Clustering	58

- Preliminary performance figures are for 640×480 images.
- Algorithm runs at approximately 2Hz for this image size.
- Real time performance would require operation at 25Hz or 30Hz.
- Real time performance is a design goal hence algorithm performance optimisation will be explored.

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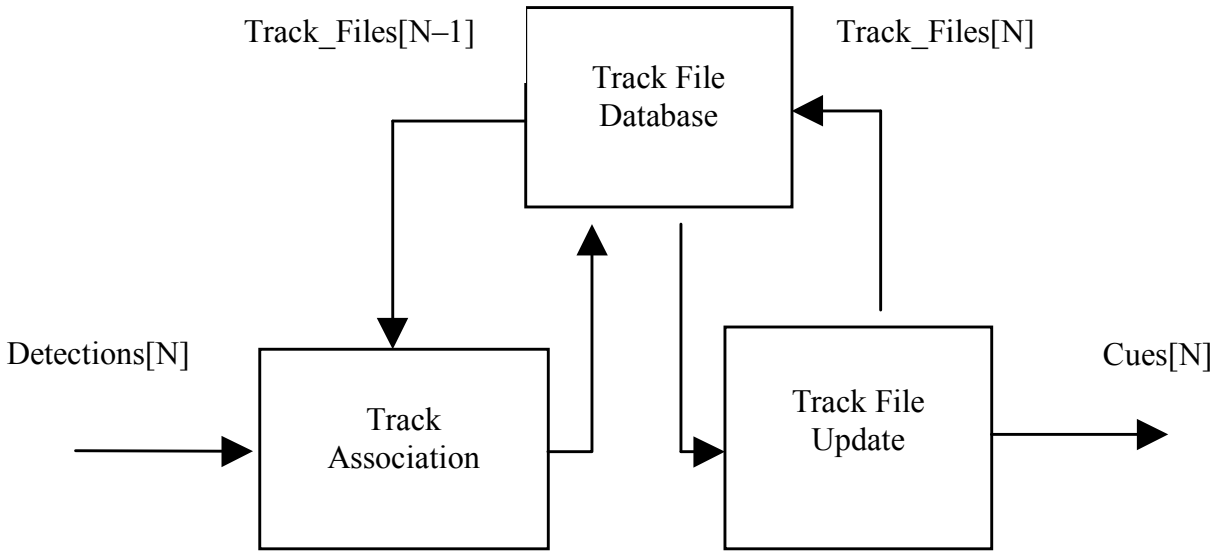
MTT



- 100% data processing
- custom primitives
- associate detections and tracks to generate cues
- low processing load

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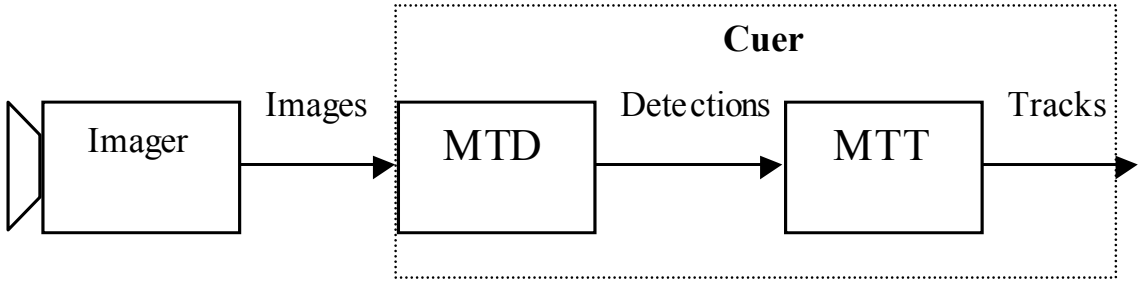
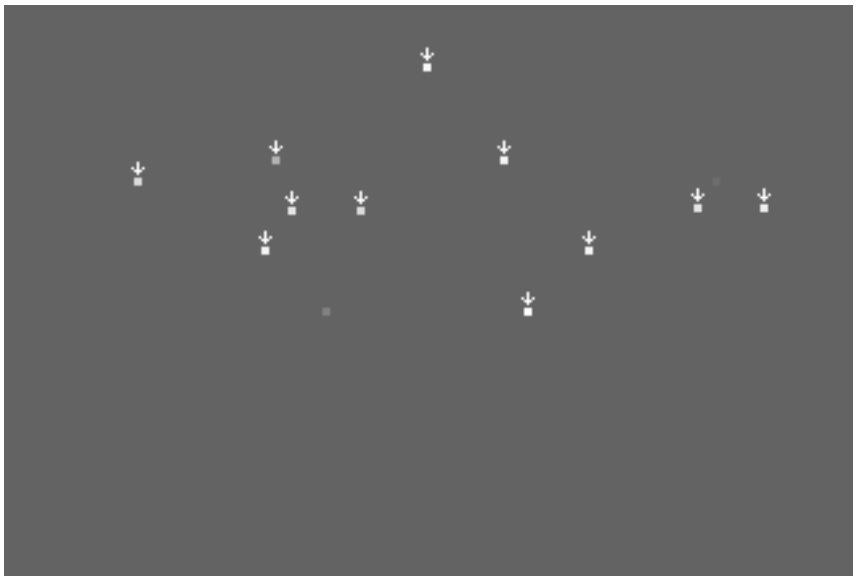
Cuer Demonstration

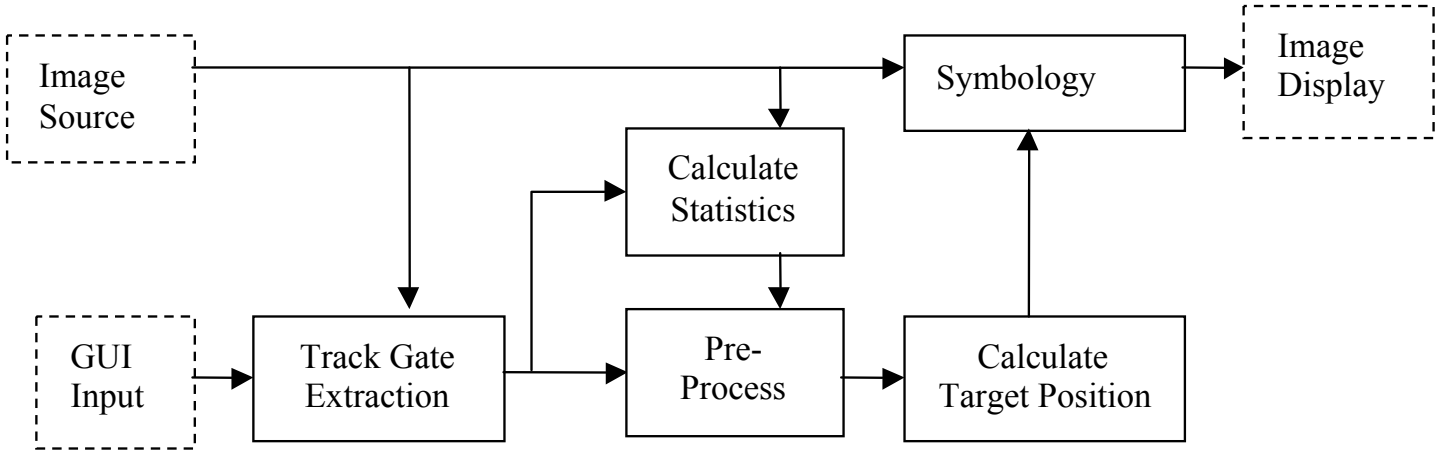




MTD Detections

MTT Cues

Tracker



Combination of image processing and data processing

Major Functions

- Track Gate Extraction
- Pre-Process
- Symbology
- Calculate Statistics
- Calculate Target Position

Tracker Implementation

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Original Implementation

- Largely GEDAE primitive based
- Use of branch/merge logic (dynamic queues)
- 222 boxes, 22 custom primitives

Workstation Benchmark

- 17 ms execution time

Alternative Implementation

- Primarily custom primitive based
- Static scheduling only
- 202 boxes, 37 custom primitives

Workstation Benchmark

- 1.7 ms execution time

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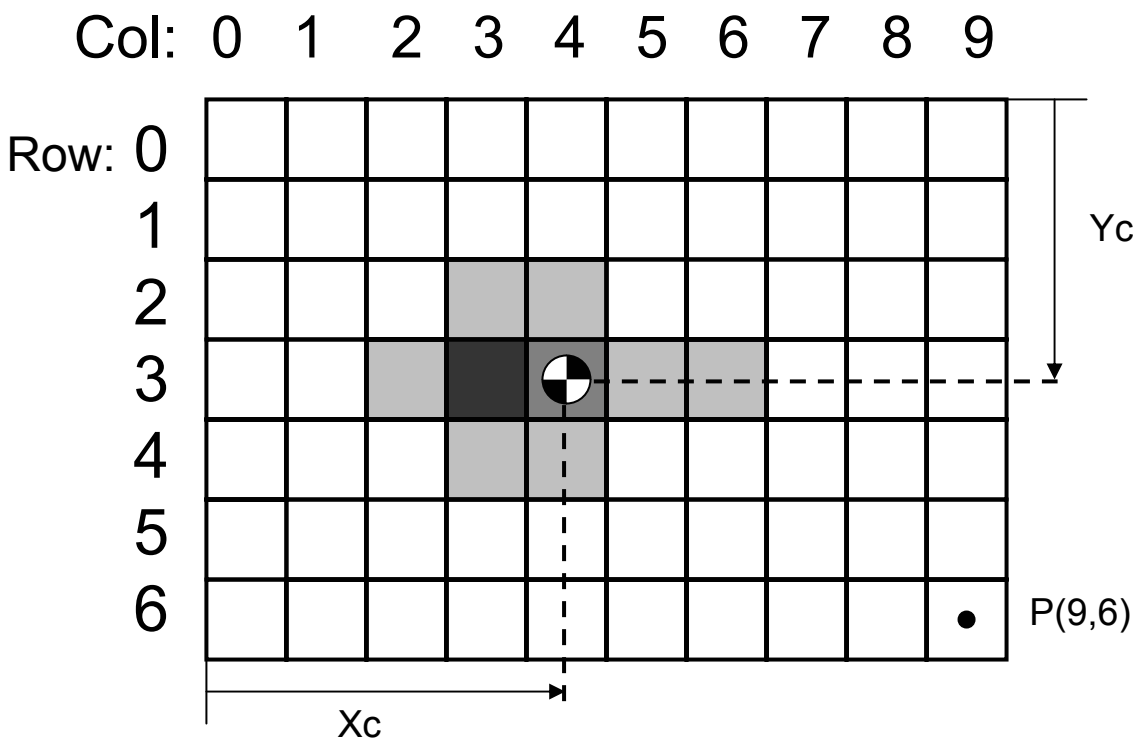
Example Alternative Design: Centroid Processing



$$X_c = \frac{\sum_{i=0}^{COLS}((\sum_{j=0}^{ROWS} P(i,j)) \times i)}{\sum_{i=0}^{COLS}\sum_{j=0}^{ROWS} P(i,j)}$$

$$Y_c = \frac{\sum_{j=0}^{ROWS}((\sum_{i=0}^{COLS} P(i,j)) \times j)}{\sum_{i=0}^{COLS}\sum_{j=0}^{ROWS} P(i,j)}$$

- X Centroid
- Y Centroid

Centroid Processing: GEDAE Implementation

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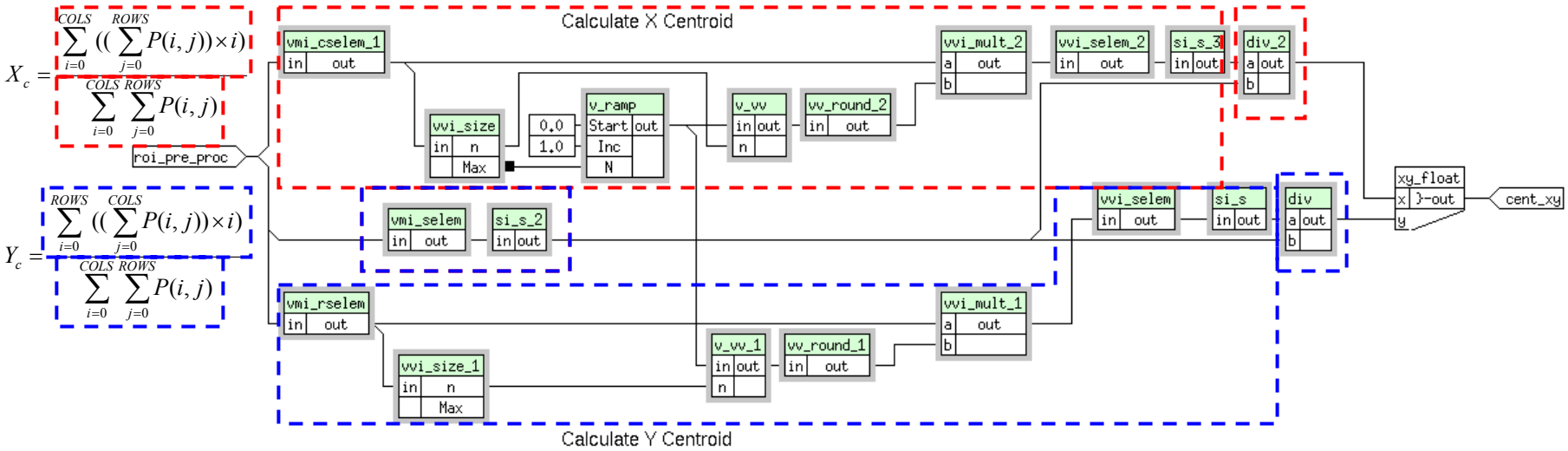
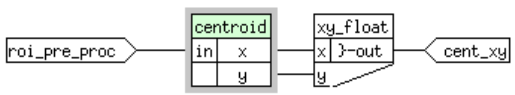


Custom Primitive Centroid Implementation

- 35 Lines of C code
- 15μs vs. 200 μs execution time



Target System/Design Benchmarking

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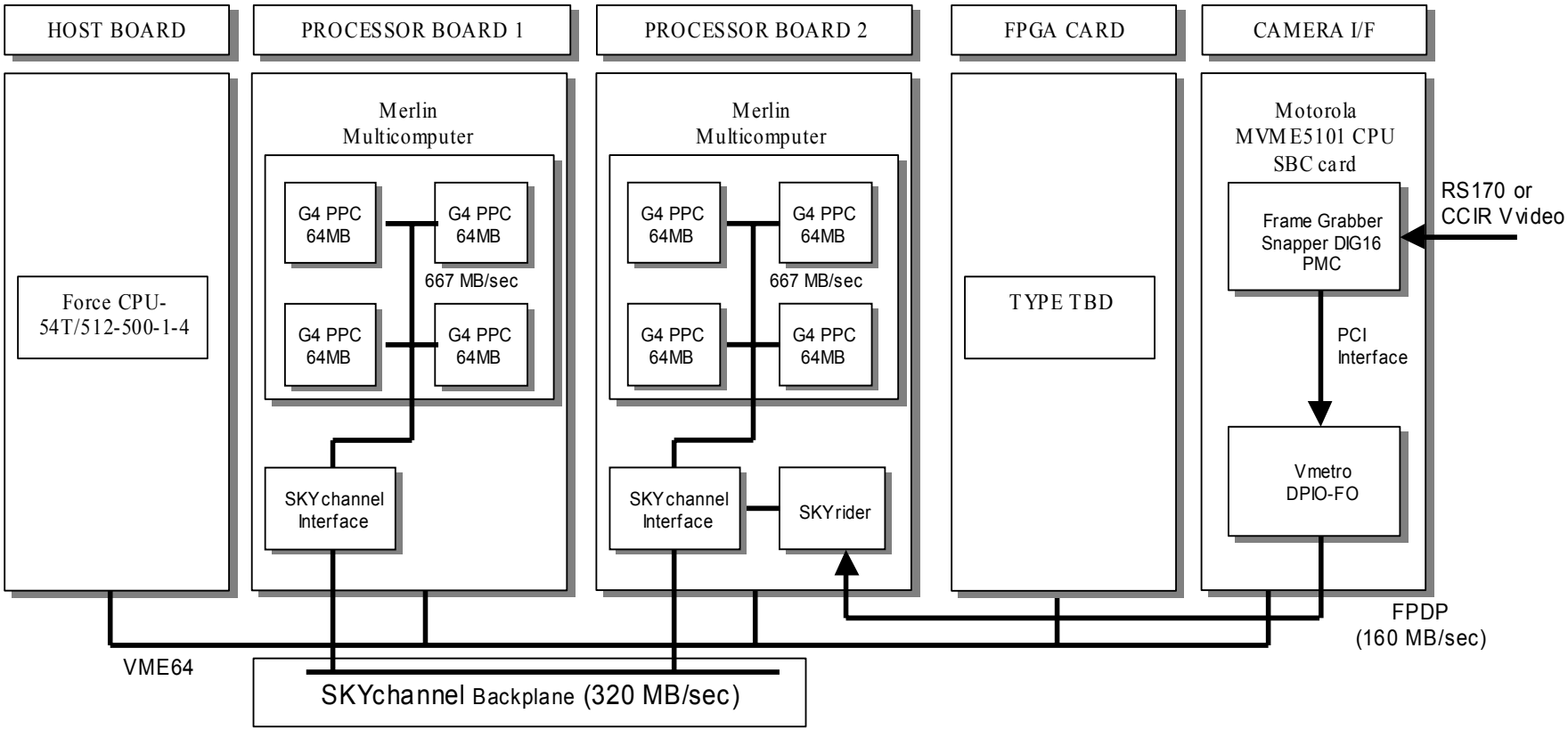

- Tracker design ported to target system with ease
- 6.7ms execution time vs 3.6ms (workstation)

Tracker Demonstration

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Conclusions

- Typical EO Processing applications such as target cueing and tracking can be readily designed
- Choice of primitive type can have a significant impact on algorithm performance.
- The ability to trade custom and library primitives as required is a tool strength
- Designs can easily be ported to a typical target system
- Application-specific libraries and an an input type-independent core library when available will improve designer productivity.
- GEDAE's block diagram design approach helps to preserve algorithm structure.

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Future Work

- Target System Designs
  - –Cuer
  - –Tracker
- Additional Target System Designs
  - –other processing structures
- Integrated EO System Model

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Summary

- Preliminary workstation designs have been produced for 2 example EO processing applications: Target Cuer and Tracker
- GEDAE can be used to implement both the image and data processing aspects of these applications
- Choice of primitive type can have a significant effect on application performance
- Porting workstation designs to a target system can be achieved with ease
- Future Work will explore GEDAE ‘s target system design tools