Autonomous Systems Design For Combat UAV Operations

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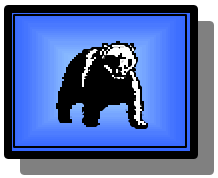
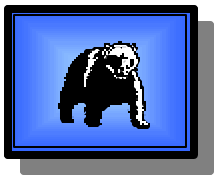


Combat UAV Autonomy Drivers

- Future combat UAVs are in general expected to be used in particularly dangerous situations.

- Typical examples:
  - Suppression of Enemy Air Defences – SEAD
  - Battle Damage Assessment (BDA)
  - Air-to-air combat

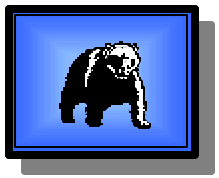


But……

- It is mandatory that military commanders retain at least the same level of operational effectiveness as with current manned systems

- There exists a tacit assumption that what we need is….

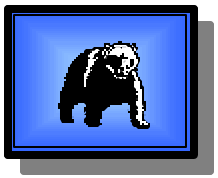
"Platform Autonomy"



Combat UAV Autonomy

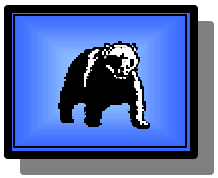
- For highly autonomous vehicles there are numerous issues in:
  - Situational awareness
  - Rules Of Engagement
  - Accountability
  - Flight certification

- These points will need to be resolved if Combat UAVs are to be employed successfully, but are more philosophical than technological



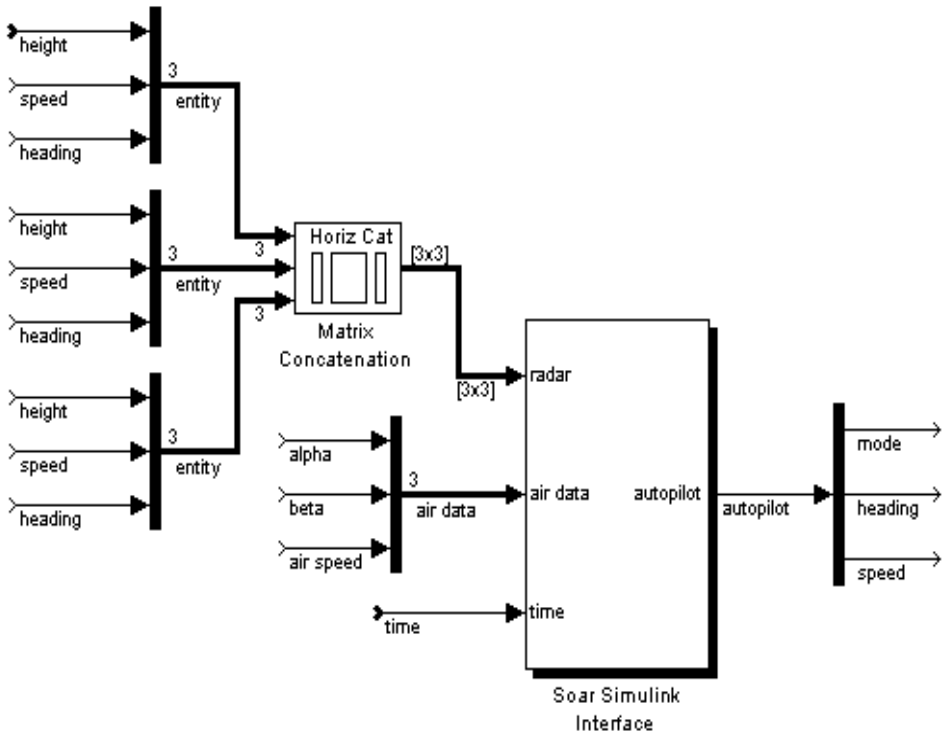
Autonomy Will Also Provide Payoff Where:

- Emission control requirements are in effect
- Jamming/system failure/line of sight communications result in loss of datalink
- An operator is required to command/supervise multiple UAVs
- Operator workload is high
- The operator may have other tasks to perform
  - e.g. as the pilot of another aircraft



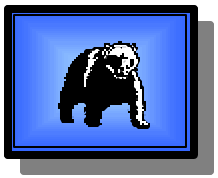
Soar/Simulink Interface:

- Self-configuring via Soar rules
- Use of the Real-Time Workshop
- Applicable to any engineering application
- Allows immediate application oriented design to begin

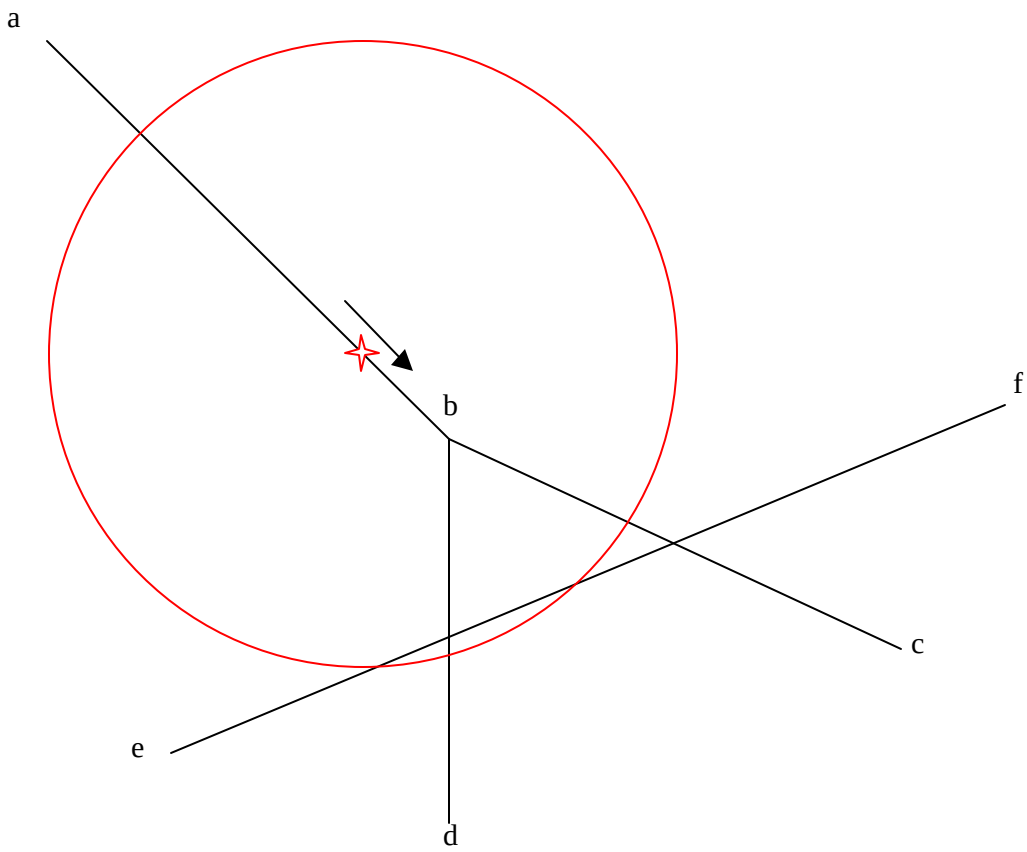


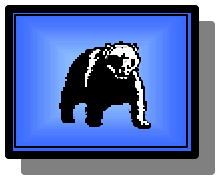
Representative Example

- Searching a network of roads for a vehicle of interest….



Searching a Road Network





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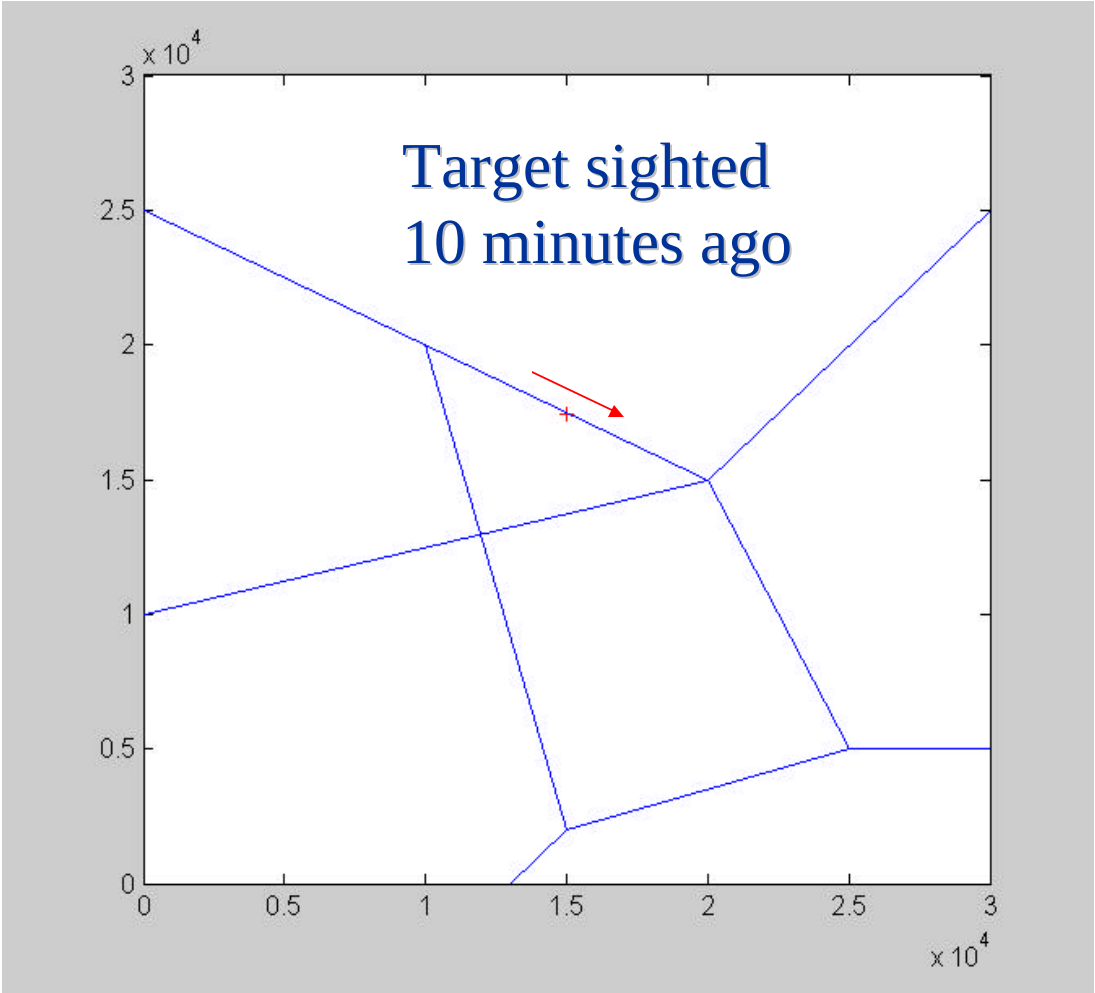
x 10^4
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5
3
x 10^4
Target sighted
10 minutes ago

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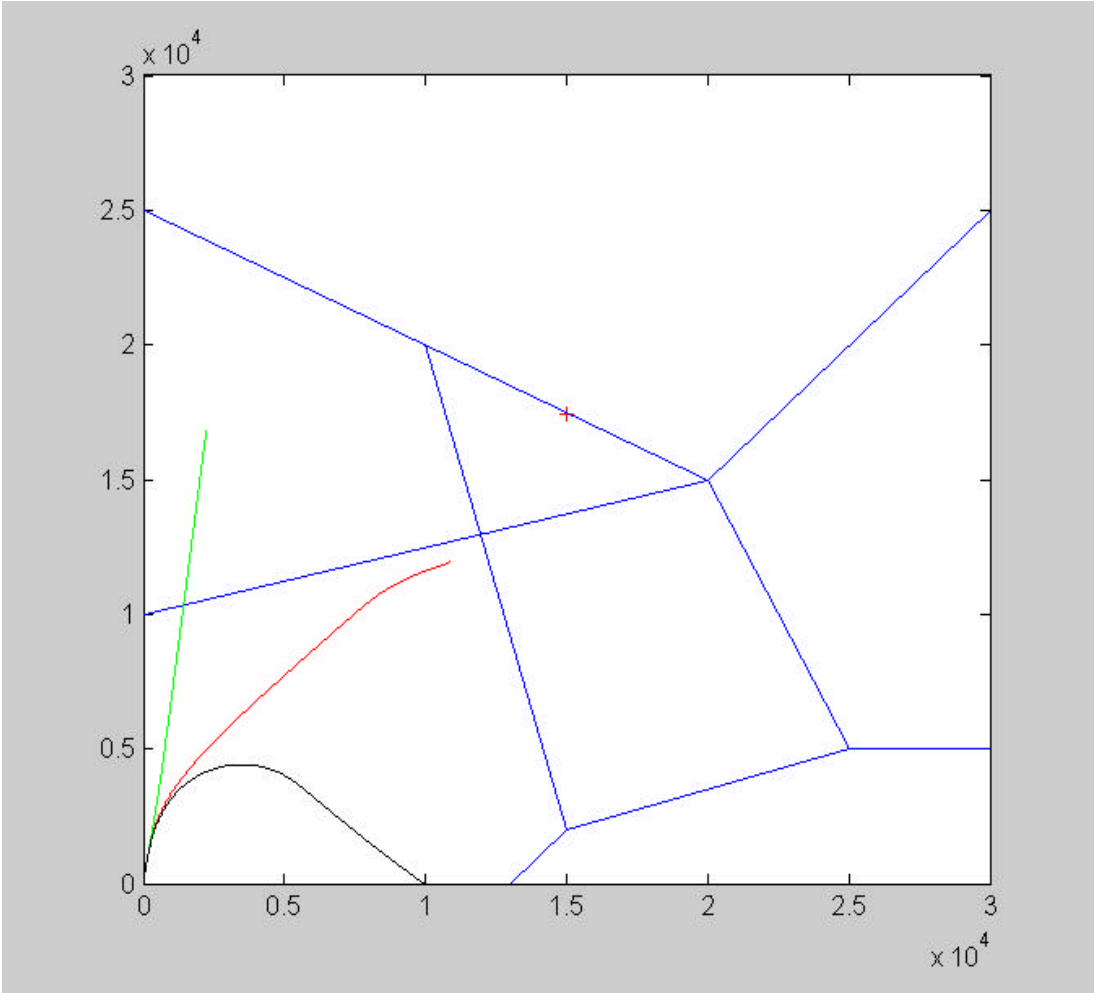

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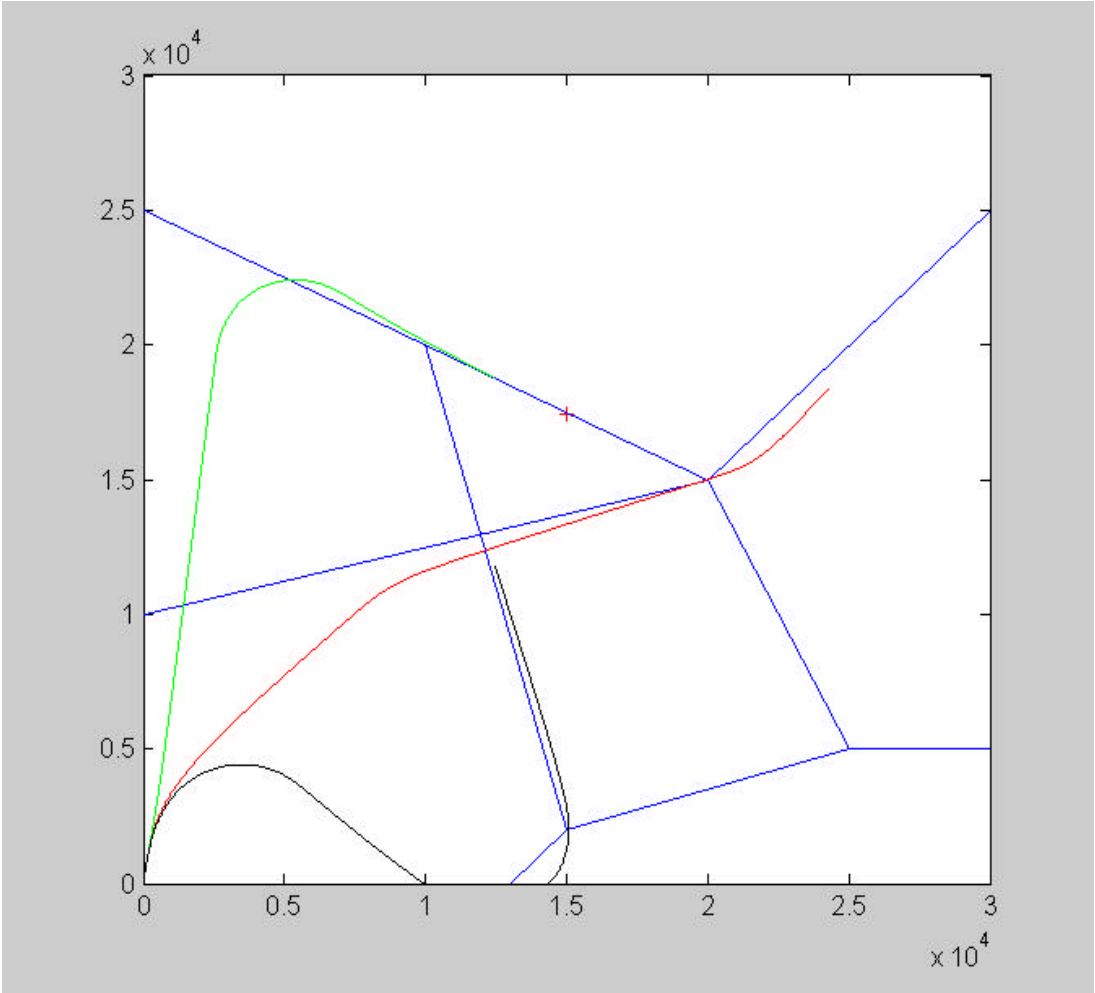

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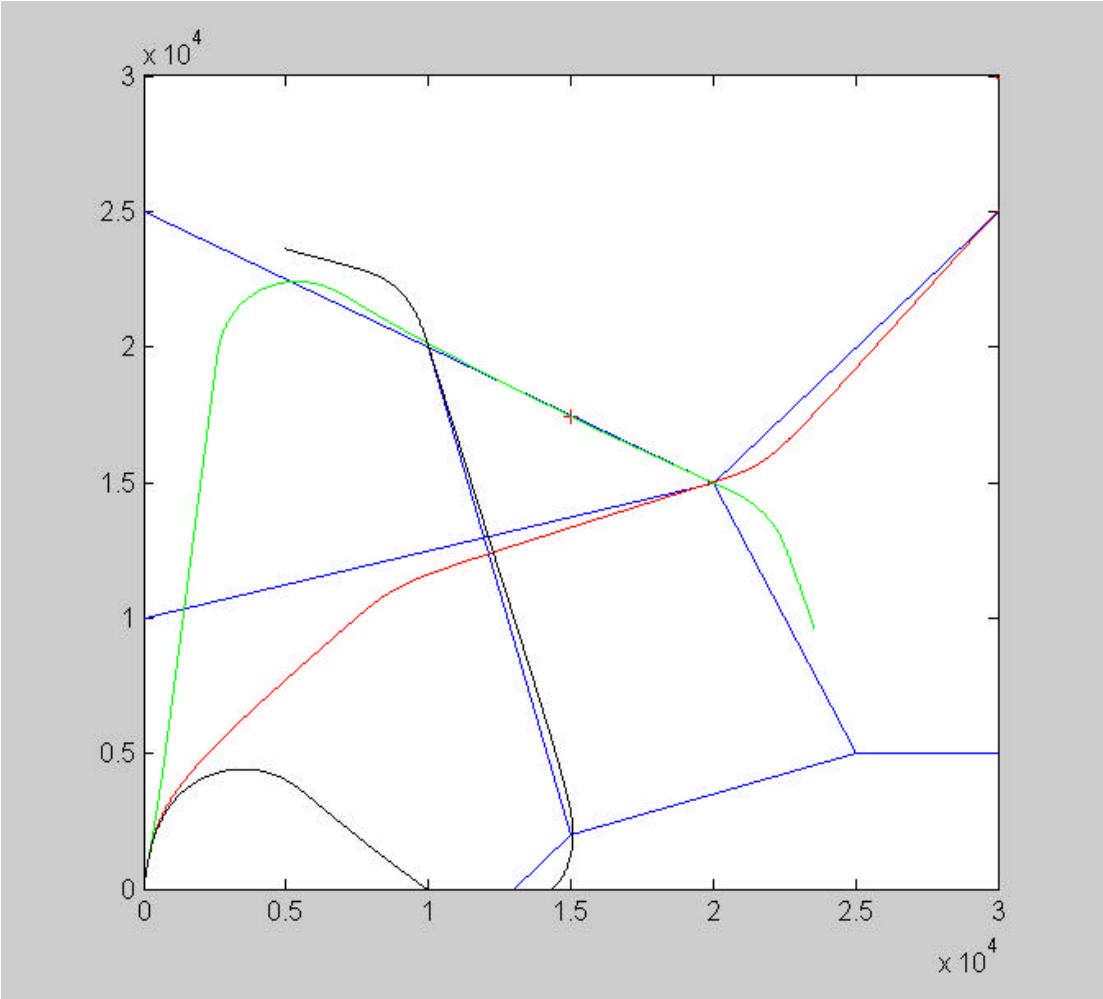

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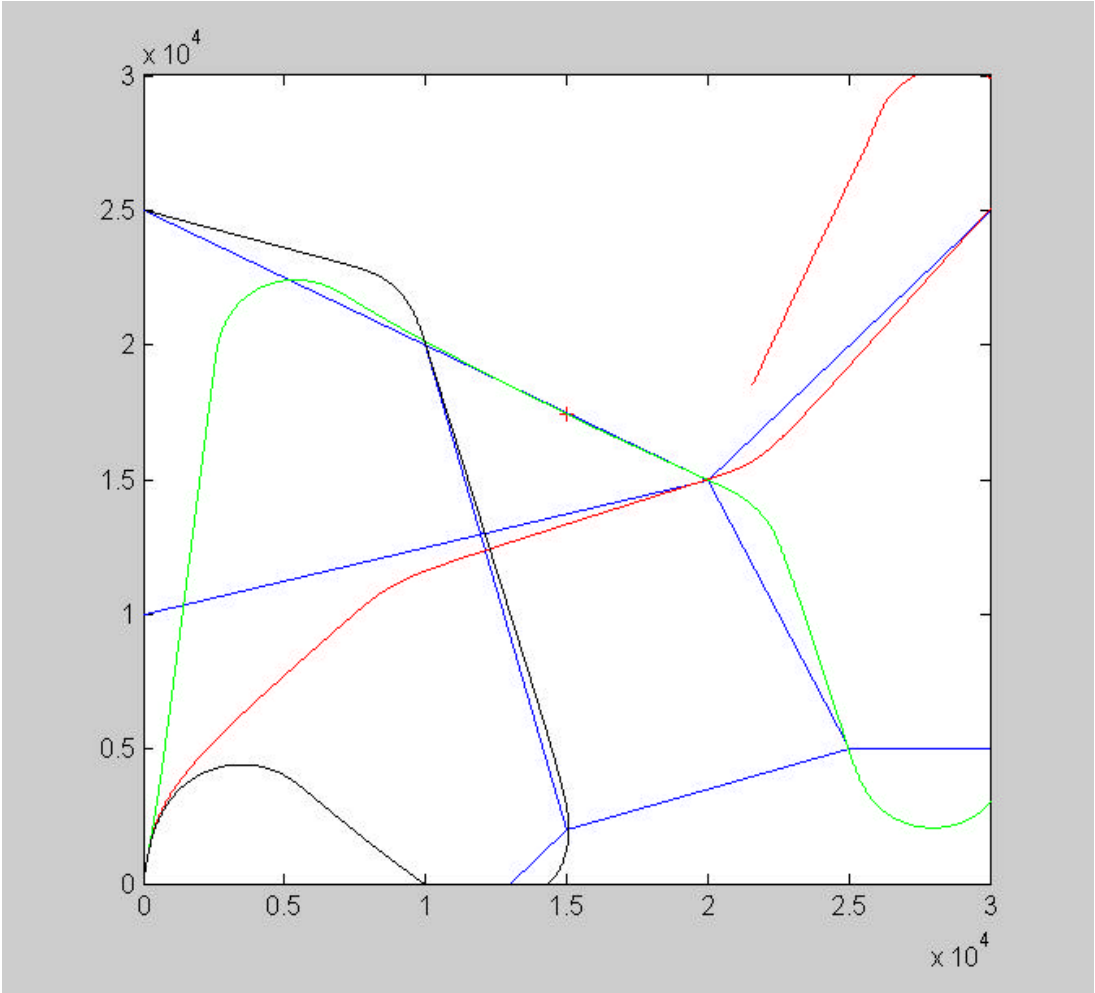

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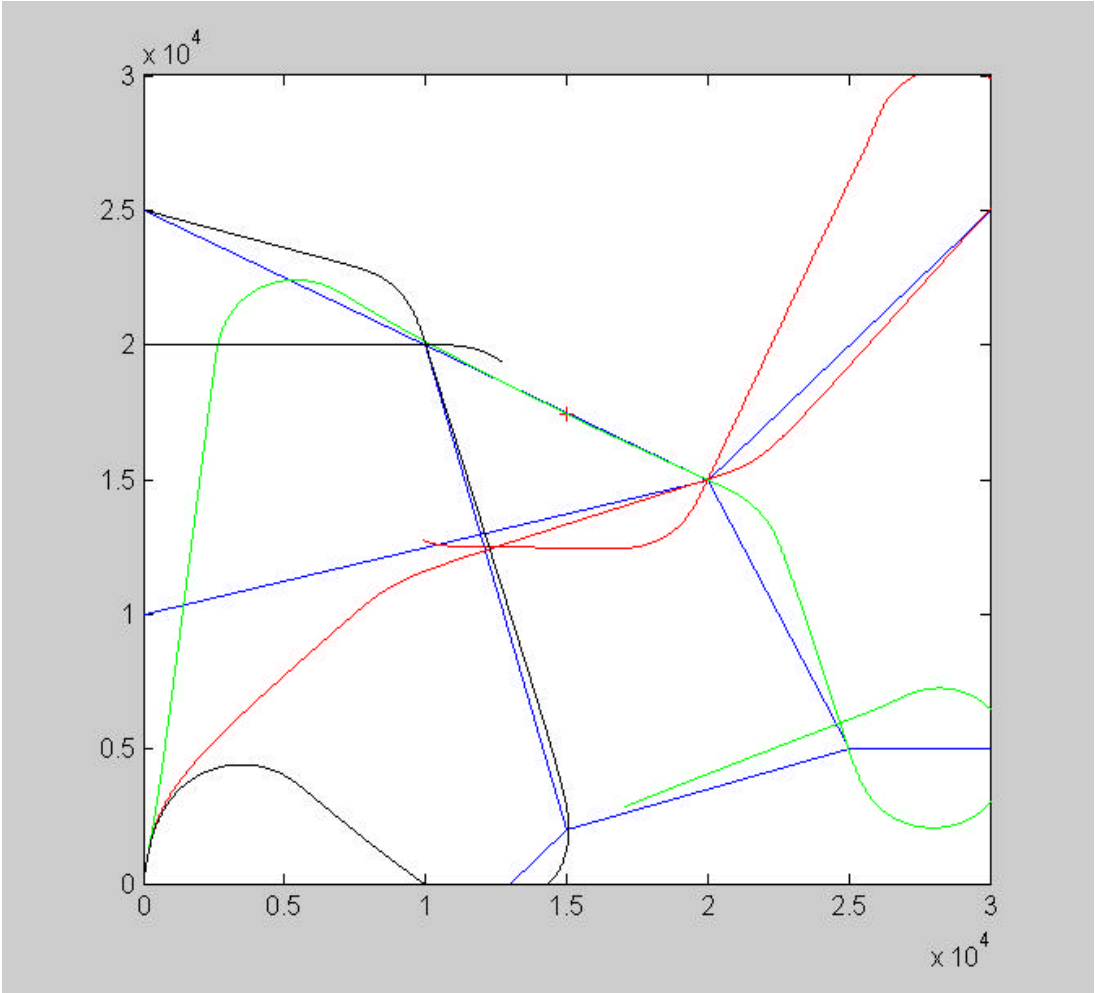

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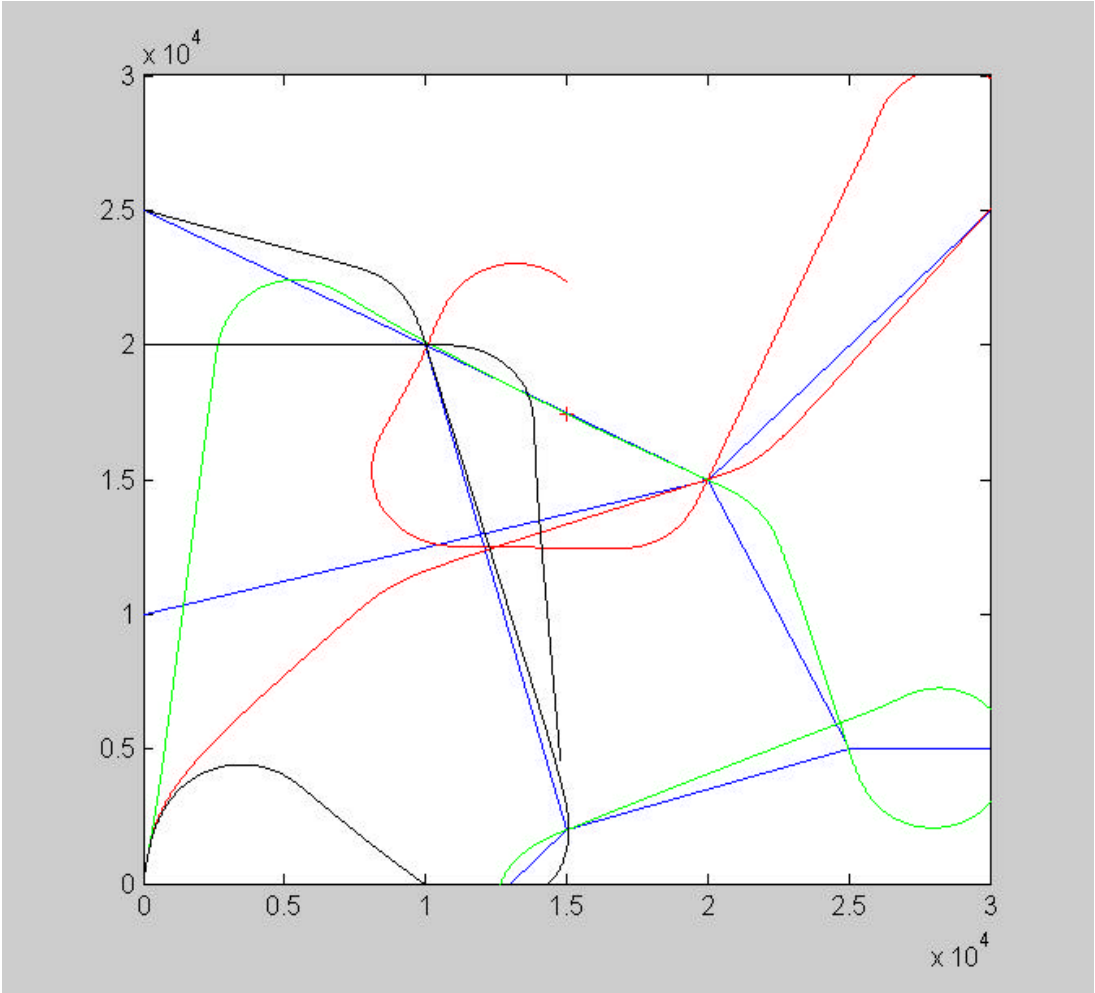

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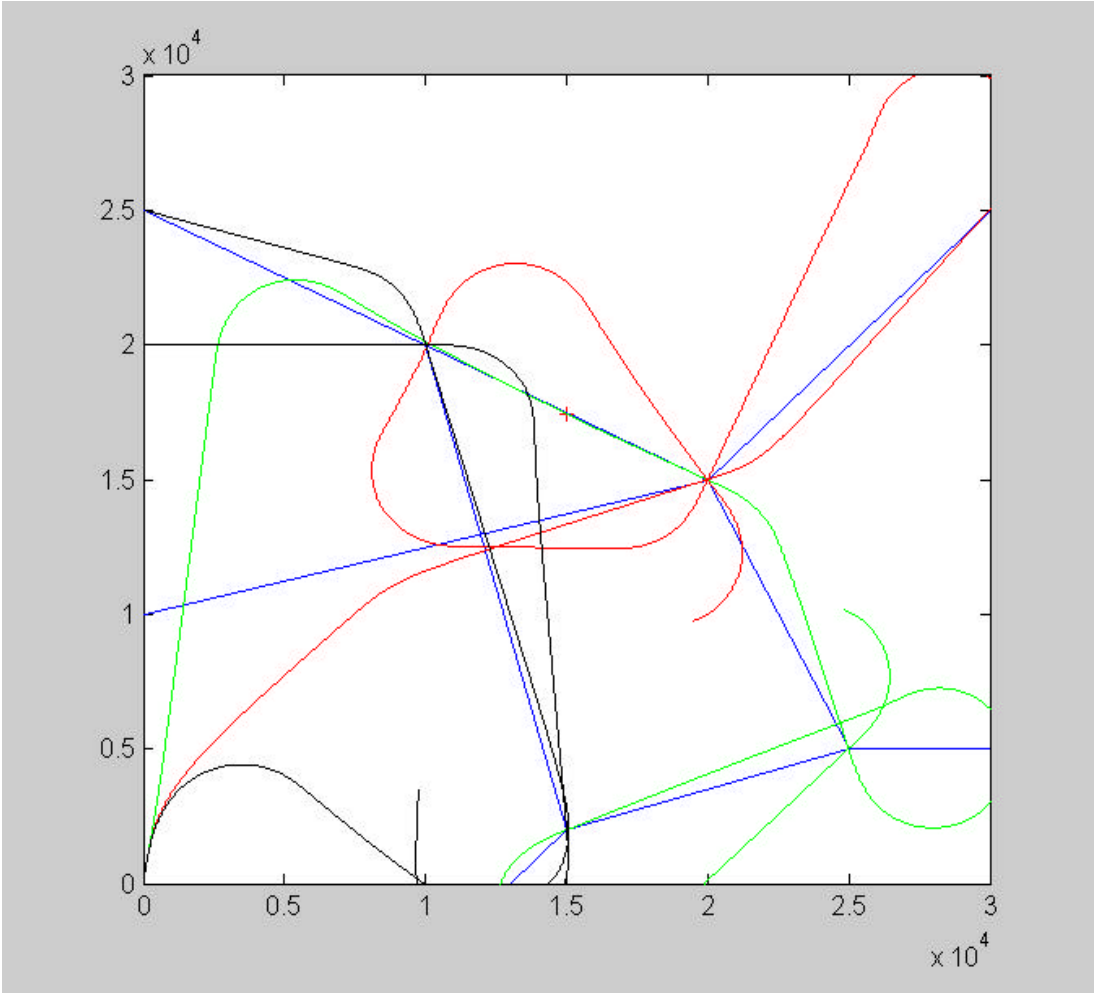

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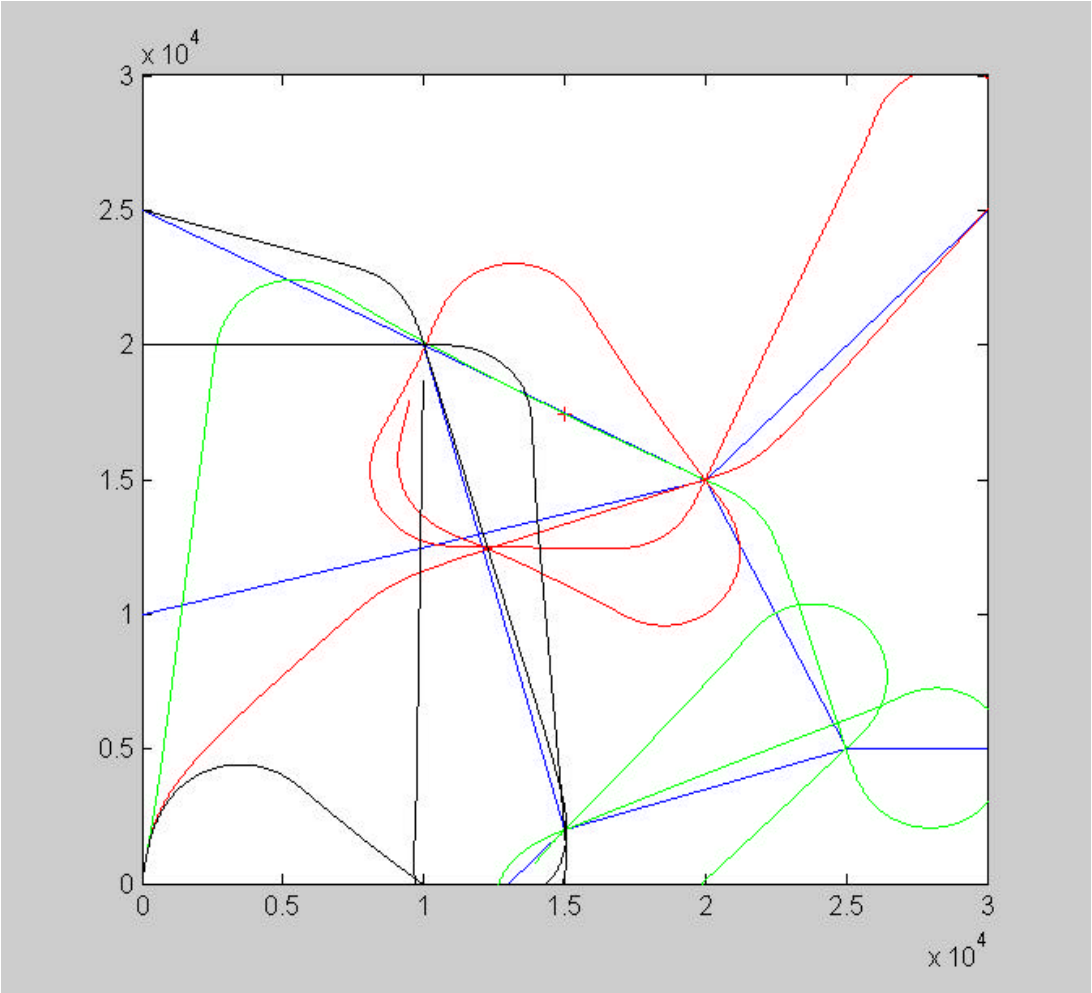
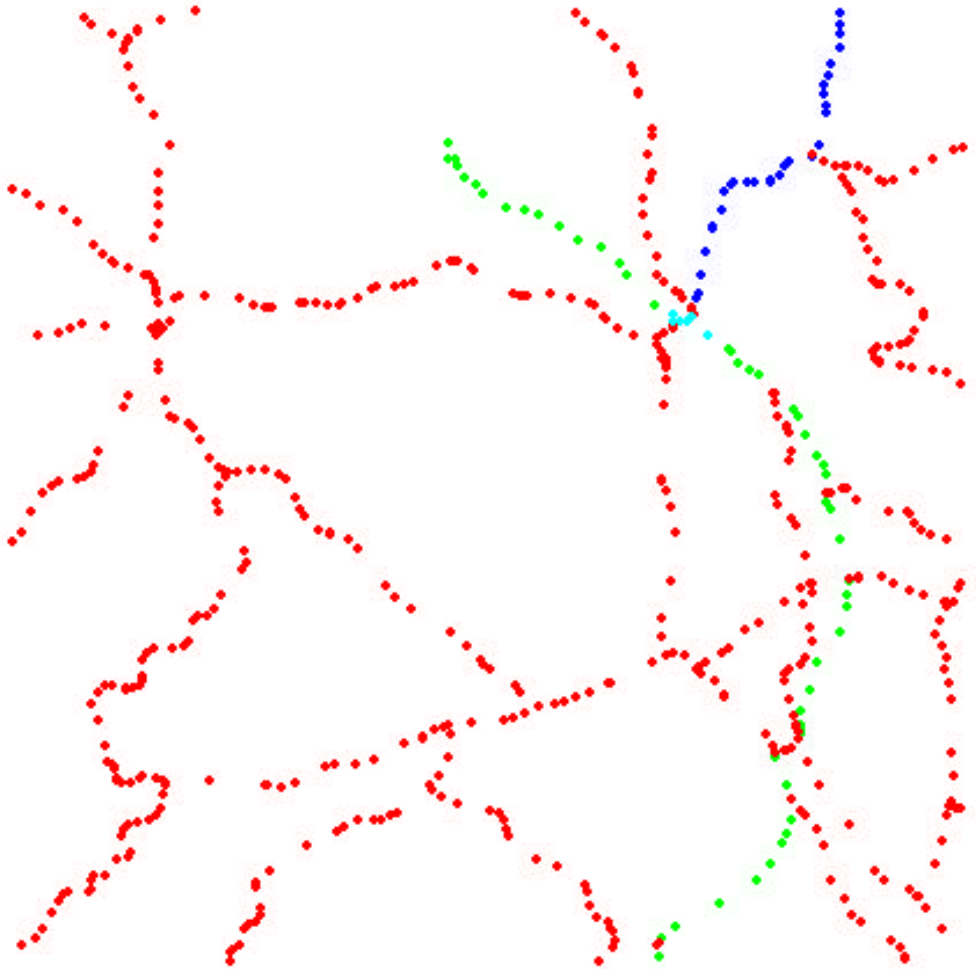
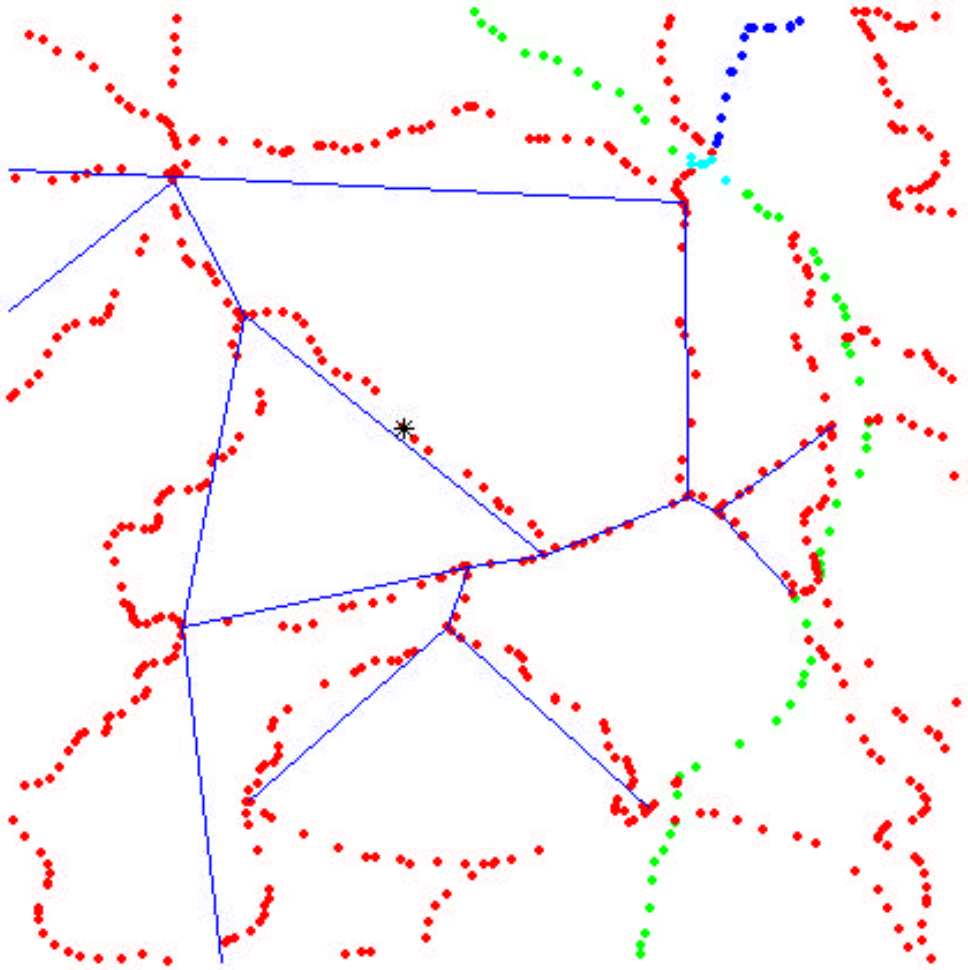


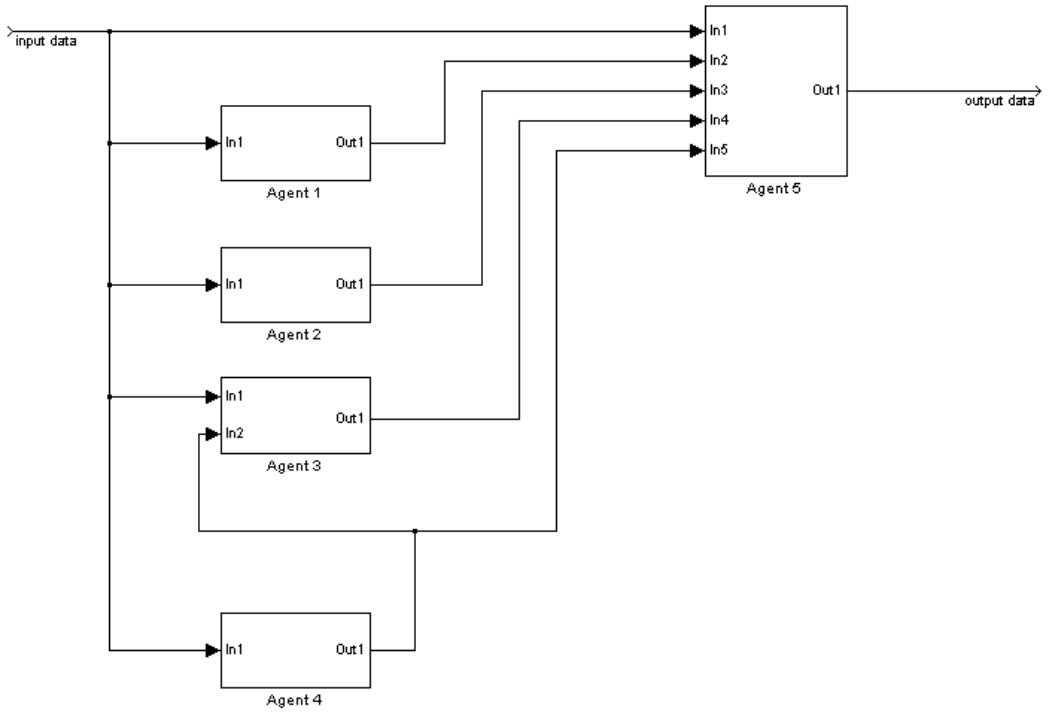
Real-World Data



Initial Analysis

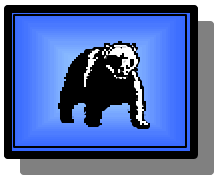


Multi-Agent Systems



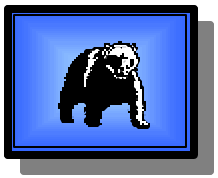
Upcoming Preliminary Flight Test

- To be carried out over the next 2 months
- Aim:
  - To function Soar in a representative engineering environment
  - To demonstrate some basic functionality
- Platform:
  - A tactical class UAV
  - 2m wingspan



Conclusions

- Autonomy will be required in future UAV systems
- A generally accepted definition of level of autonomy is required
- Typical benefits to be accrued from practical AI techniques will be:
  - Problem solving
  - Planning
  - Anticipation
  - Hypothesis forming
  - Learning
- The Soar AI language:
  - Provides a rich suite of tools for researching functional requirements of advanced autonomous systems
  - Lends itself to the practical demonstration of advanced concepts



- Questions?