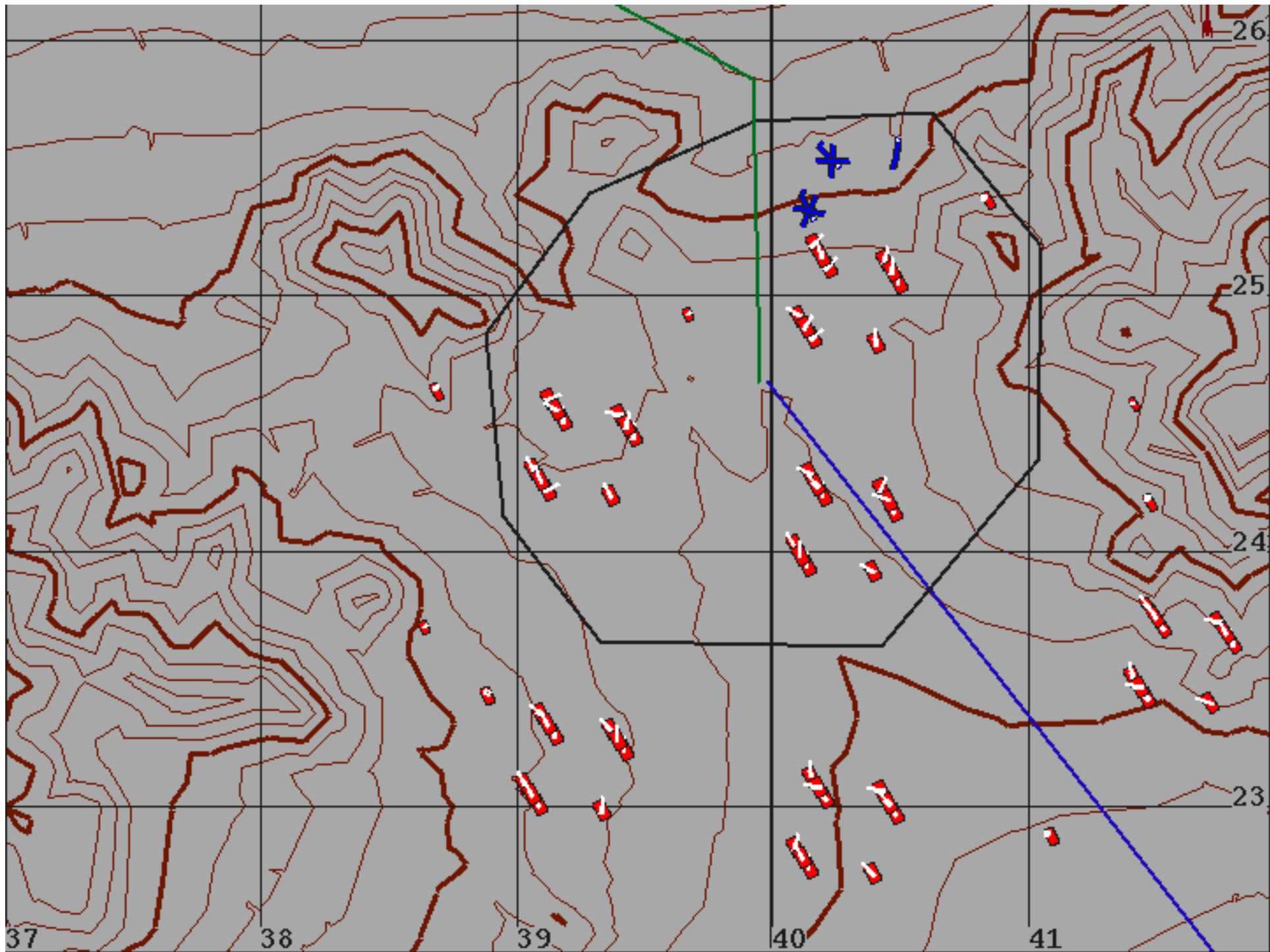# Perception in RWA/IFOR

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Perceptual Challenges

- n *Agents overwhelmed by visual input*
  - *spikes in the demand for visual processing*
  - *load increases with number of entities seen*
  - *handling of visual input affects survivability*
- n *Agents need to perceive groups*
  - *support team activities*
  - *report the sighting of a group*
  - *perform situation assessment*

Visual Processing

n *Each decision cycle:*

- *scan for visual objects*
  - *sense 360°, 7 km*
  - *add new visual objects to input-link*
  - *get state information for extant objects*
- *maintain clusters*
  - *re-compute geometric relations to cluster*
  - *split clusters when appropriate*
- *cluster new entities*
- *re-compute geometric relations to entities*

Analysis of Perceptual Costs

- n **Spikes in Computational Demand**
  - • *contributing costs*
    - – *create visual objects for entities perceived*
    - – *cluster visual objects*
- n **Background Load**
  - • *overhead costs*
    - – *update visual objects on the input-link*
    - – *maintain clusters*
    - – *maintains a table of all entities ever seen*

Improving Perceptual Processing

- n *Reduce the number of new visual objects processed in one DC*
  - *addresses spikes in visual processing*
- n *Reduce the number of entities on the input link*
  - *addresses load of visual processing*
- n *Selectively reduce visual processing per visual object (UM approach)*

Focus of Attention

n ***Voluntary attention***

- *Agent specifies attention criteria:*
  - *force: opposing or friendly*
  - *vehicle type (guise): AH64, T72, ...*
  - *vehicle class: RWA, Tank, AAA, ...*
  - *slant range: 0-7 km*
  - *cluster id: integer assigned in SMI*
- *Default: nothing accepted*
- *Addresses the load problem on input-link*

Focus of Attention

- n *Enforce a visual processing limit*
  - *retain sensing strategy (360°, 7 km)*
  - *postpone processing until next dec. cycle*
- n *Active vision approach*
  - *limit the sensor's range and angle of focus*
    - *should limit number entities processed per DC*
  - *actively point the sensor to cover scene*
    - *raises issues about effective search strategies*

Perceiving Groups

n *Clustering*

- *bottom-up clustering*
  - *proximity based algorithm O(n)*
- *top-down clustering*
  - *agent specifies the members of a cluster*
  - *used for team tracking*
- *compute attributes*
  - *quantity, quantity-by-type*
  - *location (center-of-mass, bounding-box)*
  - *geometric relationships (wrt center-of-mass)*

Related Work

- *Treisman et al. (80,82,85,88): selective attention*
- *Logan (96): integrated theory of visual attention*
- *Hayes-Roth (90): reasoning about capacity & use of filters*
- *Bajcsy (88): active perception*
- *Ballard (91): animate vision*
- *Firby et al. (95,96): architecture for vision and action*
- *Chella et al. (97): cognitive architecture for artificial vision*
- *Newell (90): UTC*

Conclusions

- **n** *Nuggets*
  - *improved performance should be possible by limiting/delaying visual processing*
  - *perceptual grouping provides a useful abstraction for understanding visual scenes*
- **n** *Coal*
  - *delayed processing not implemented*
  - *not exploiting voluntary attention*
  - *have not tested UM approach*