TIGER

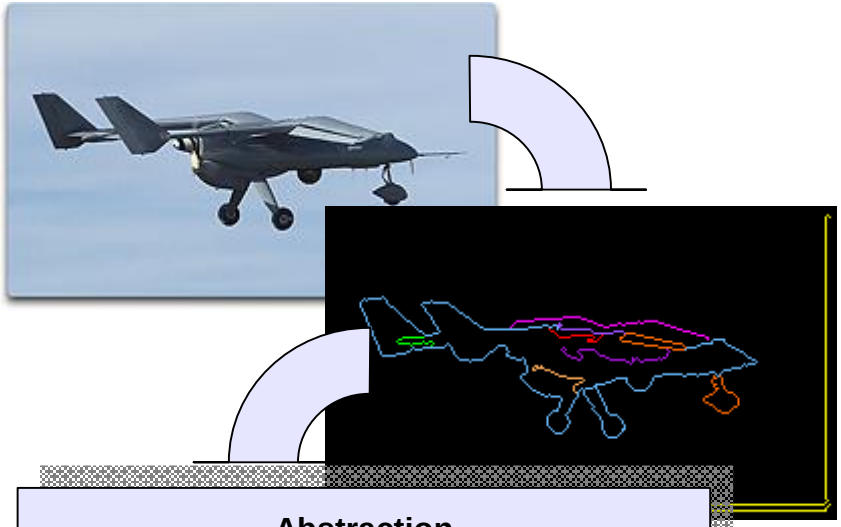
SEAS DTC Conference, 2009

Outline

- Data Abstraction:
  - Overview of process
  - Mathematical foundation
  - Object Recognition spectrum
- TIGER:
  - Deep Vision's role
  - Dynamic information content
- Conclusions

The Language of Form

- The Language of Form (LoF) is a mathematical theory of curve representation.
- Boundary curves provide a geometric representation of objects in imagery.
- Representing/abstracting curves provides a means through which objects can be represented in imagery
- LoF curve abstractions are invariant of rigid-body motion on the underlying curves.

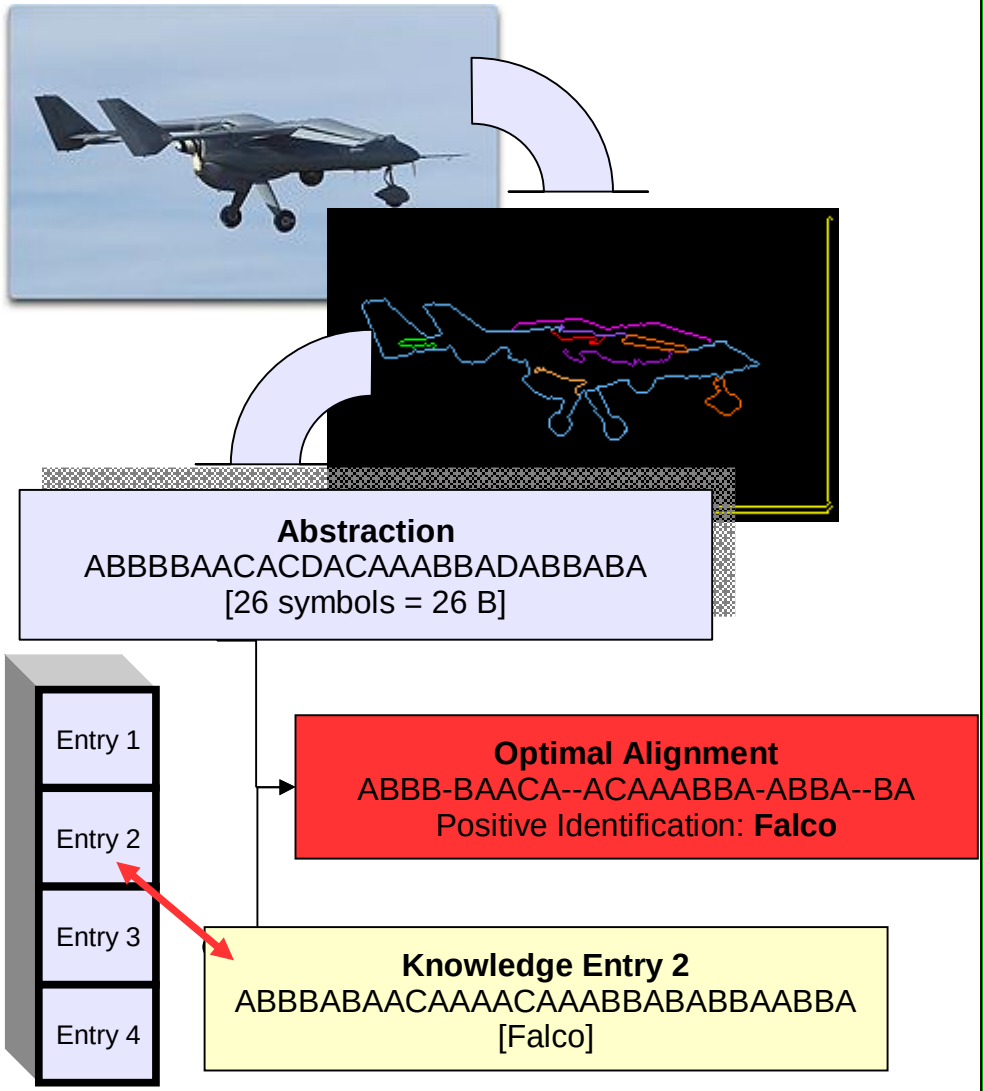


Abstraction
ABBBBAACACDACAAABBADABBABA
[26 symbols = 26 B]

- Boundary curves are generated from input imagery.
- Each boundary curve is abstracted.
- Each abstraction generalises an equivalence class of objects.
  - e.g. the 26 B abstraction (above) represents that projection of the UAV at any scale, position, or orientation.

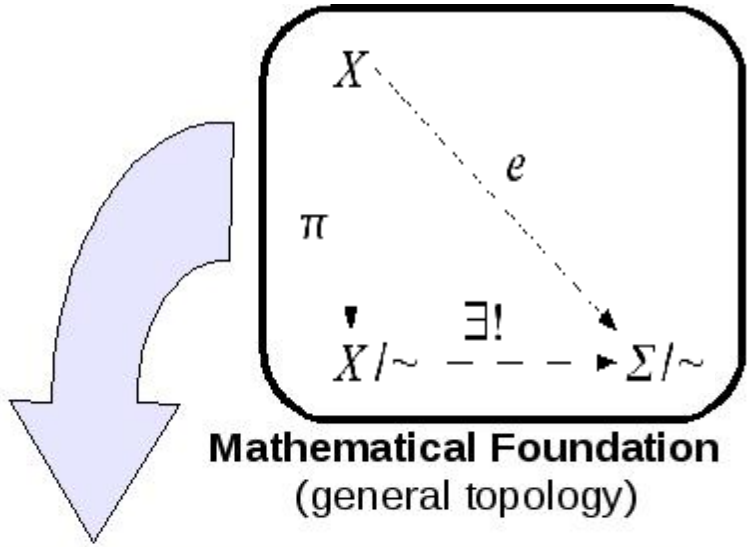
The Language of Form

- Abstractions generated from the data boundary curves are compared against the members of a knowledge base
- Alignment scores indicate the similarity between strings, which implies geometric similarity between the represented forms.
- Positive identification/recognition occurs whenever a data abstraction sufficiently matches a knowledge base entry.

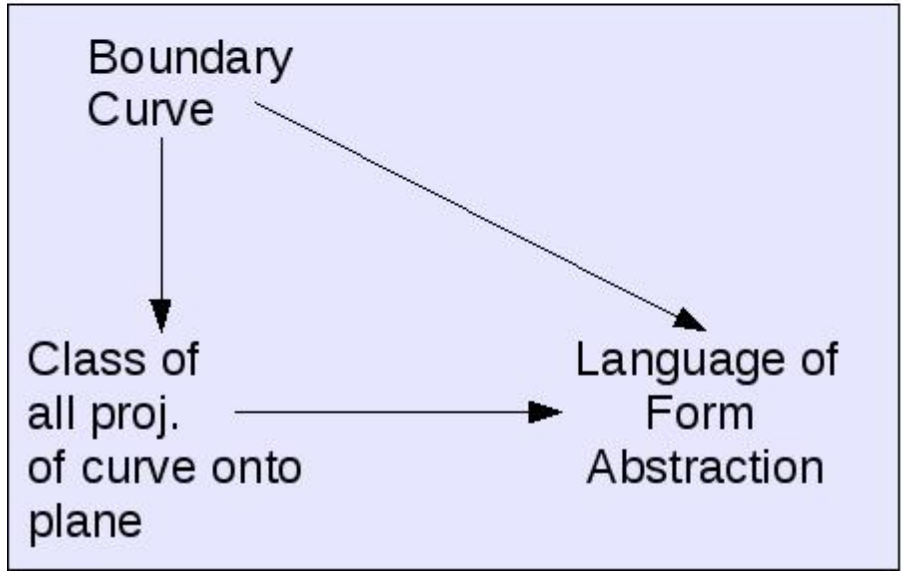


The Language of Form

- Mathematically, an abstraction in the Language of Form is in one-to-one correspondence with an equivalence class of curves.
- Each curve in the equivalence class can be scaled and rotated (in the perspective plane) to be made equal to one another.
- A single abstraction can be used – without modification – to identify an object invariant of that object's projection onto the plane.

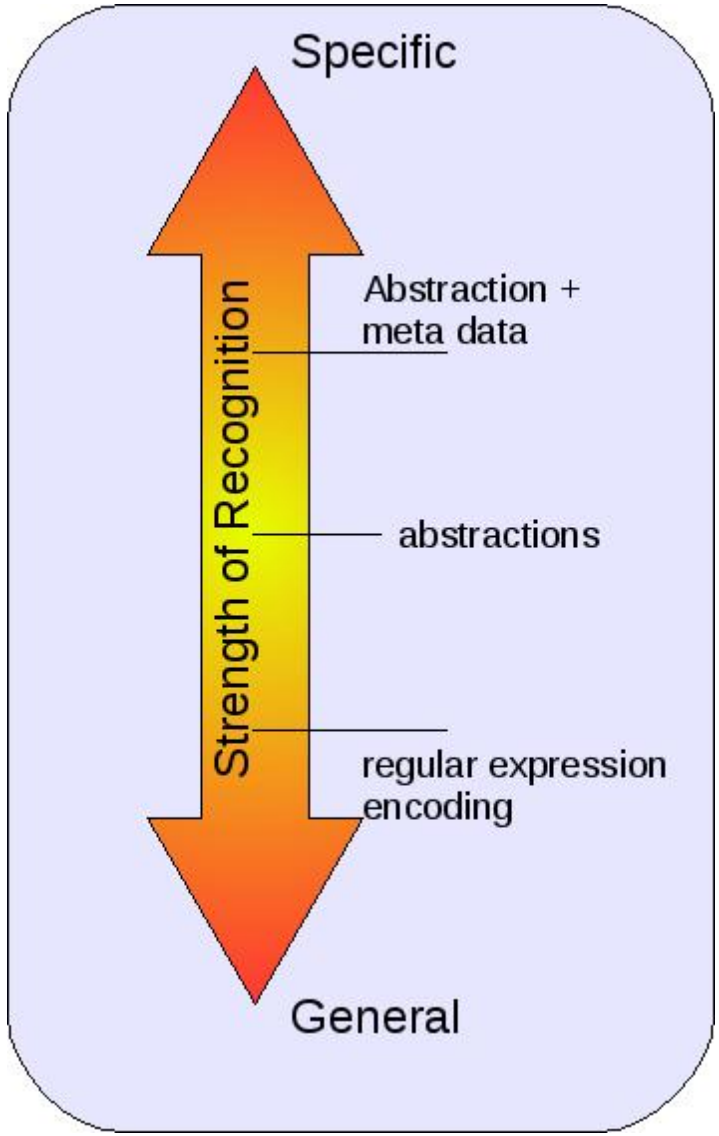


Mathematical Foundation
(general topology)



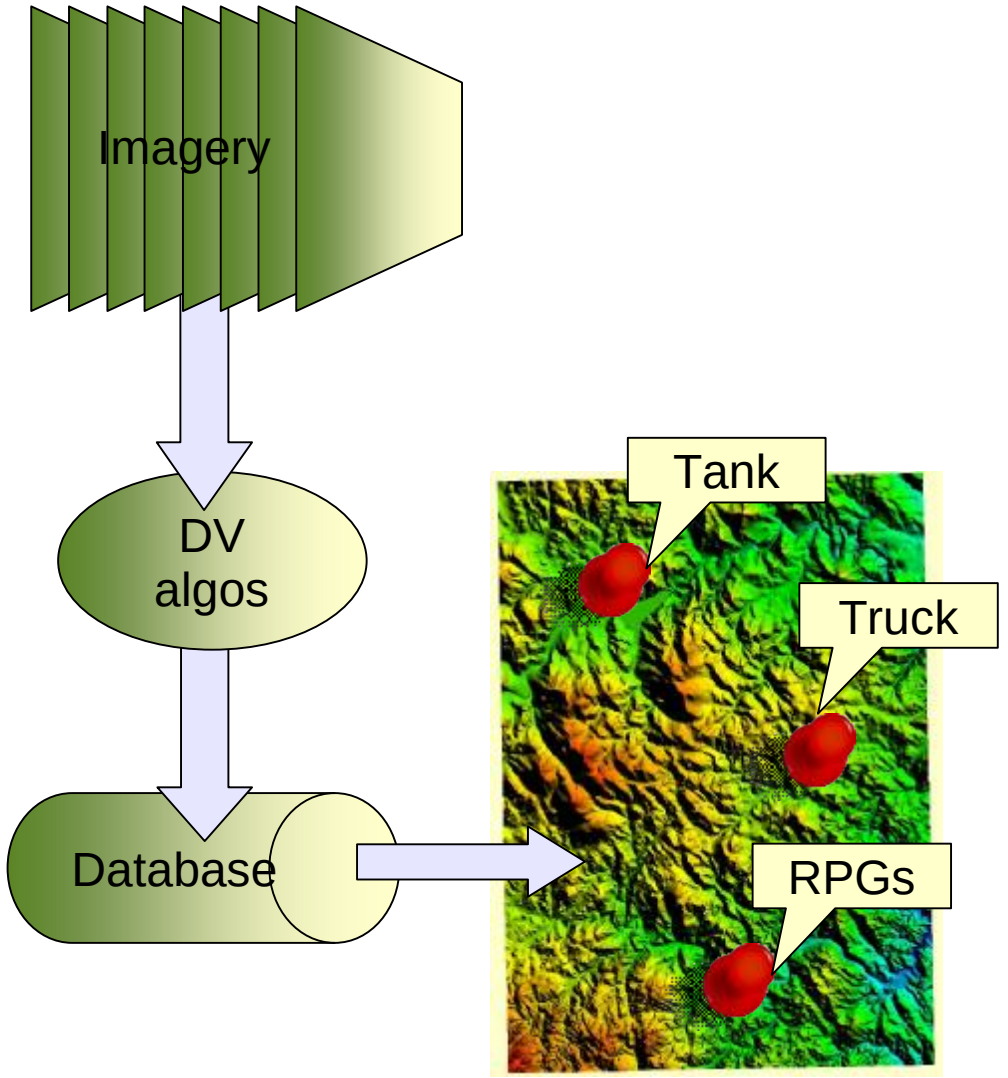
The Recognition Spectrum

- Object recognition similar to dictionary search.
- Similarities characterised by string/sequence alignments.
- Advanced recognition (partial object, occlusion, deformations) enabled by local sequence alignment techniques
  - e.g. Smith-Waterman alignment algorithm
- Regular expression techniques enable classes of geometrically distinct, but perceptually similar, objects to be represented by a single regular expression.
  - e.g. one regular expression abstracts a variety of fonts, distinct cars, etc.

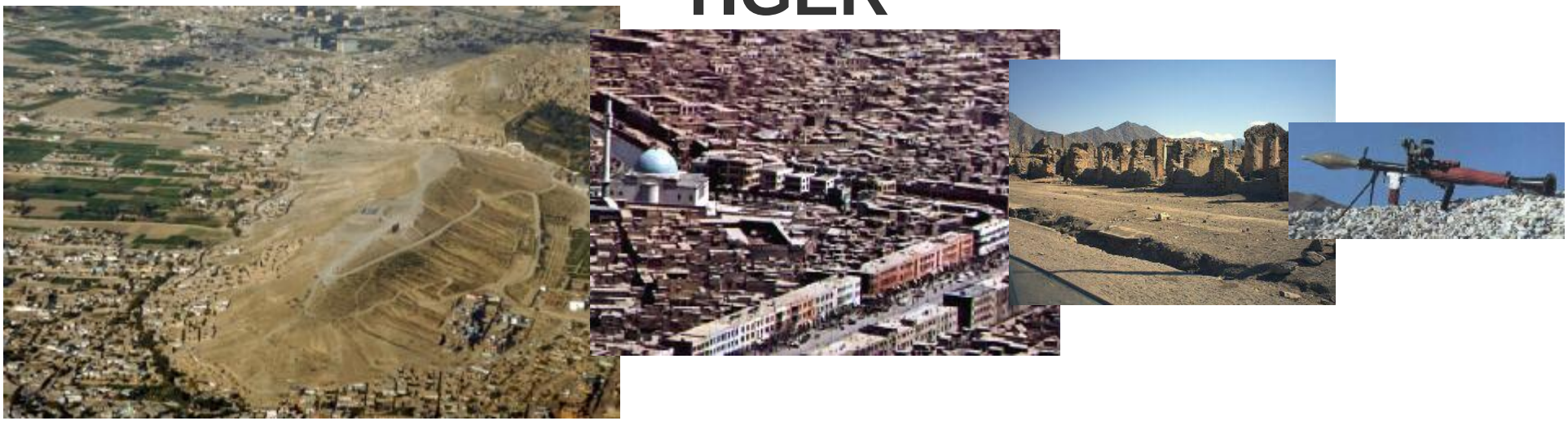


TIGER

- Deep Vision will be assisting in TIGER by providing existing algorithms developed in SEN014.
- The algorithm set enables the following capabilities:
  - Abstraction of data from input imagery.
  - Filtering of data against a knowledge base.
  - Output of filtered abstractions to a database.
- This will allow:
  - The user to select an element from a list and identify all points on a map containing an instance of that object



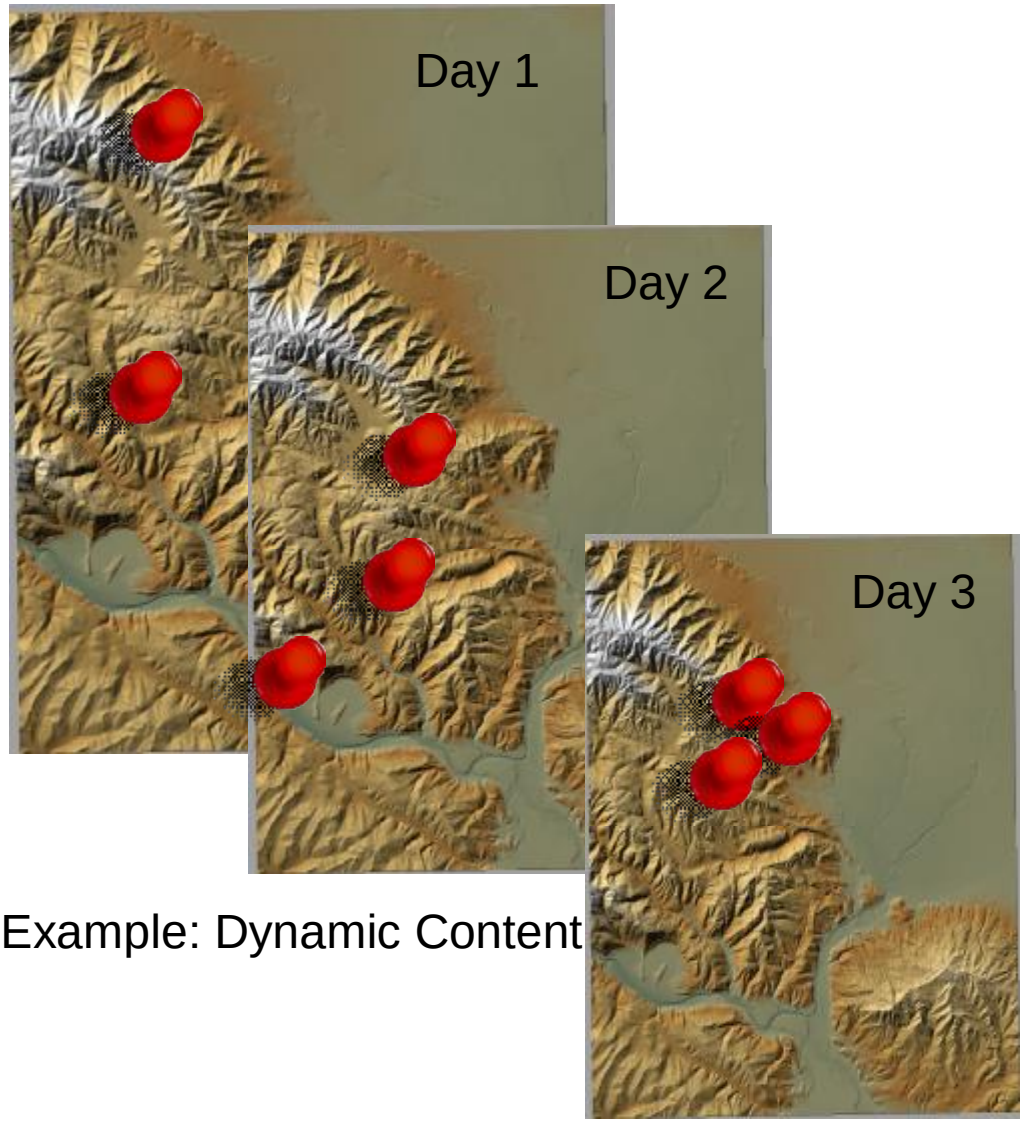
TIGER



- Supplied imagery may represent multiple scales, allowing for specific abstracted data/information to be accurately pinpointed on a larger scene/map
  - e.g. locations of a specific threat in an aerial view of a city.
- Deep Vision's efforts will focus on generating specific information from the input imagery, while additional processes will register, fuse, and align the imagery, allowing for specific information to be extracted from large areas.

TIGER

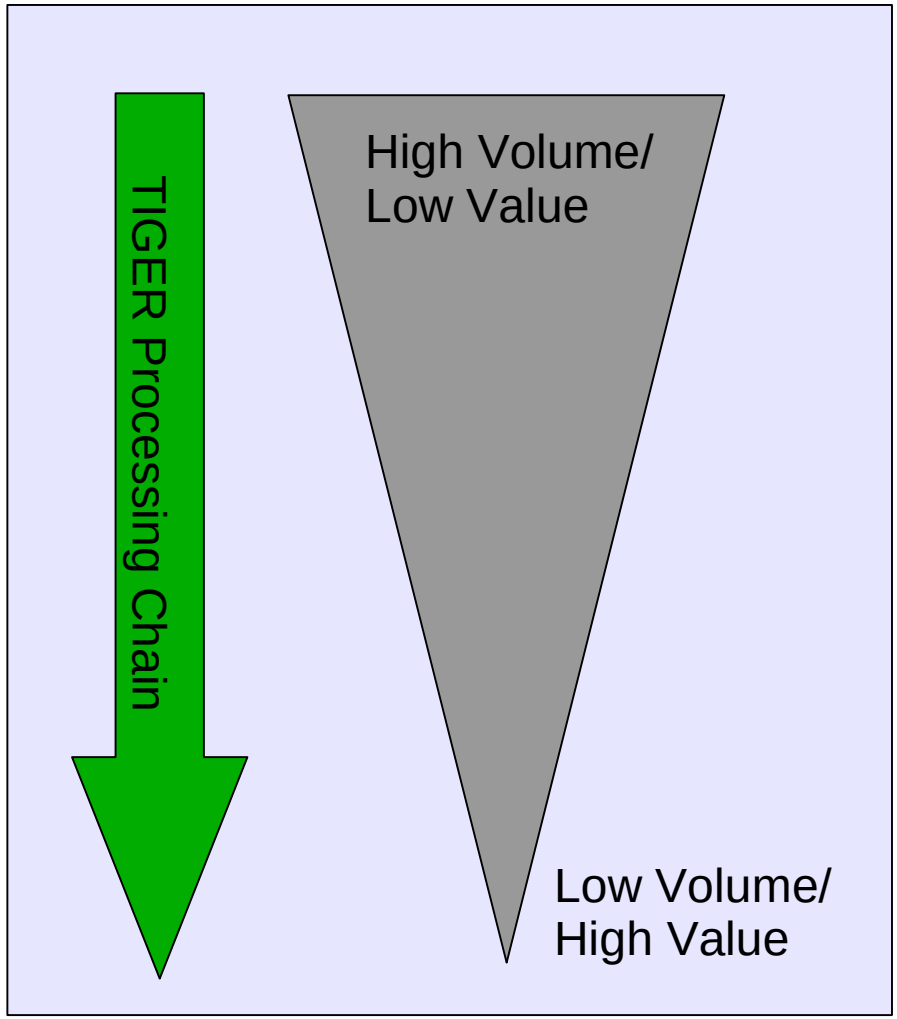
- Simplistically, Deep Vision will assist the TIGER programme by enabling the attachment of information to a map.
- The exact type of information depends upon the knowledge base supplied
  - The knowledge base will be constructed to suit the particular application.
- This will allow dynamic information content by updating the map and database as new imagery is supplied to the system.
  - The information content available through the database, and displayed on the map, varies as observed situations change.



Example: Dynamic Content

Conclusions

- Deep Vision's data abstraction technology will be employed in the TIGER programme to enable information to be extracted from imagery and referenced on a map.
- Individual images are processed by Deep Vision, and the abstractions are filtered against a knowledge base.
- All abstractions matched against a knowledge base will represent recognised objects.
- The abstraction, labels, and further meta-data (if necessary) will be pinned to a map.
- This will allow for the information content of the map to be updated dynamically and at the frequency with which new imagery is acquired.



Thank you!

For more information on TIGER, contact

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