

Thinking... *inside* the box



# Robustness in Behavioral Modeling

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# Brittleness

- Knowledge problem
  - Not a representation problem
- Affects any sufficiently rich computational system
  - Humans are not immune, though much better
- There is no remedy
  - There are mitigation methods

# Building Robust CGFs

- Software engineering approach
  - Modular & hierarchical structure
  - Verify user input
  - Explicit assumptions
- Artificial intelligence approach
  - Common sense reasoning
  - Qualitative physics

# Causes of Brittleness

- Erroneous specification
- Incorrect logic
- Incomplete knowledge
- Obsolete information

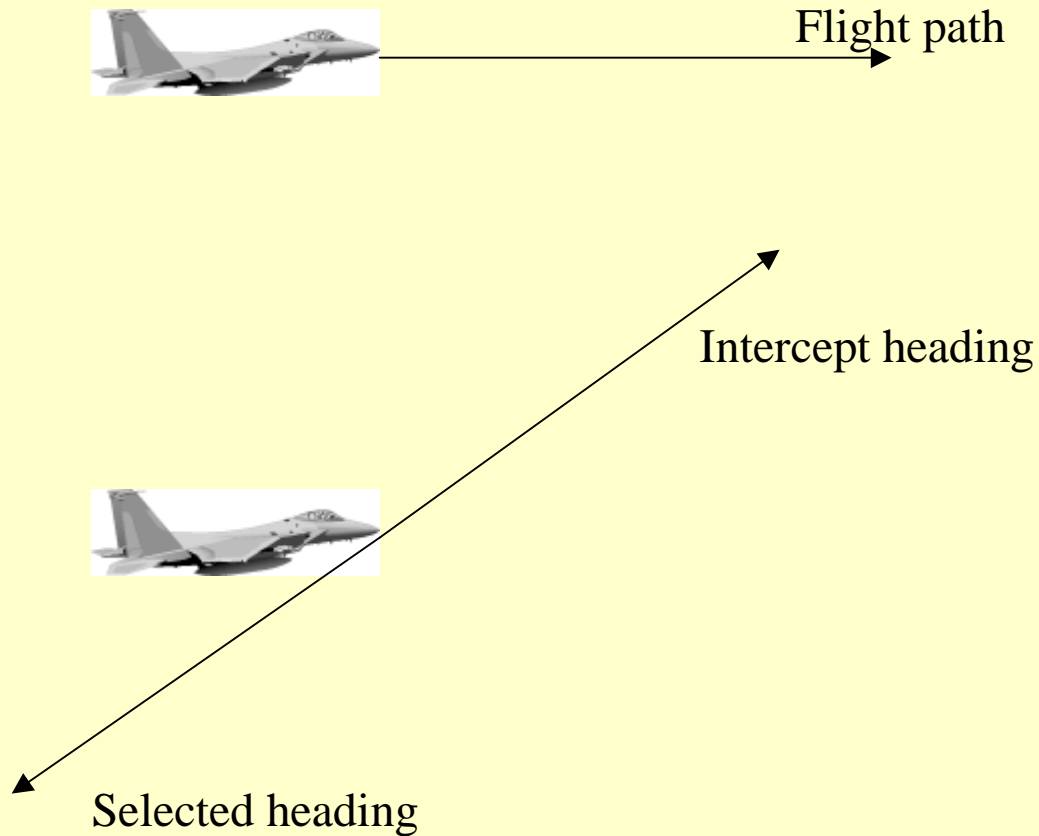
# Erroneous Mission Specification

- Current system assumes domain expert
  - In practice someone familiar with domain
  - Goal: Usable by a novice
- Proposed solution :
  - Mission definition
    - Test assumptions
  - Runtime checking
    - Confirm inputs well formed
    - Test information not available at definition
    - Detect as early as possible

# Incorrect Logic

- Appear to know exactly what to do
  - What they do is wrong
- Proposed solution :
  - Progress measurement
  - Provides intermediate testable metric
  - Error detection
  - Error response : Warn rather than fix

# Example

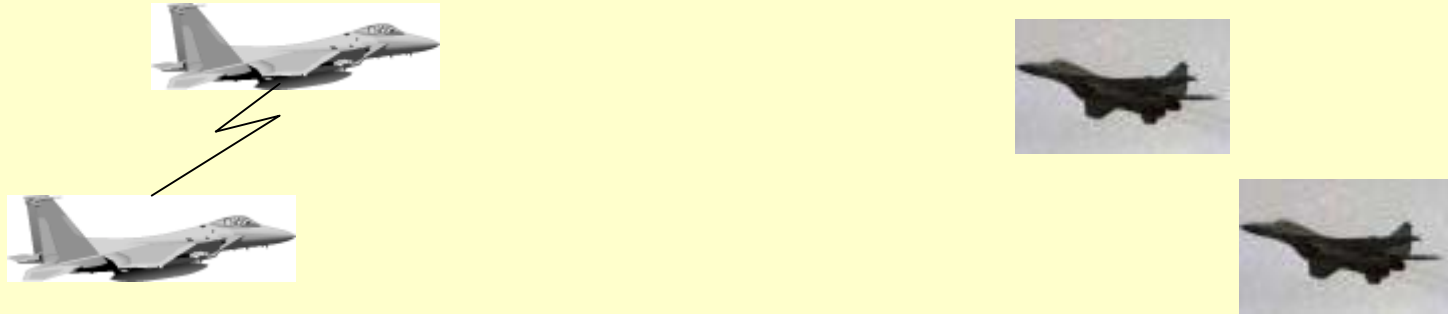


# Incomplete Knowledge

- Missing information to make a decision
- Soar explicitly recognizes lack of goal progress
  - Recognized as state no-change
  - Automatic subgoaling
  - Normally additional knowledge fills in gaps
- Proposed solution :
  - Provide default “common sense” knowledge at lowest goal levels
  - Provide recovery information on intermediate goals
  - Allow user guidance



# Example



Communicate: “Range sort”

# Example



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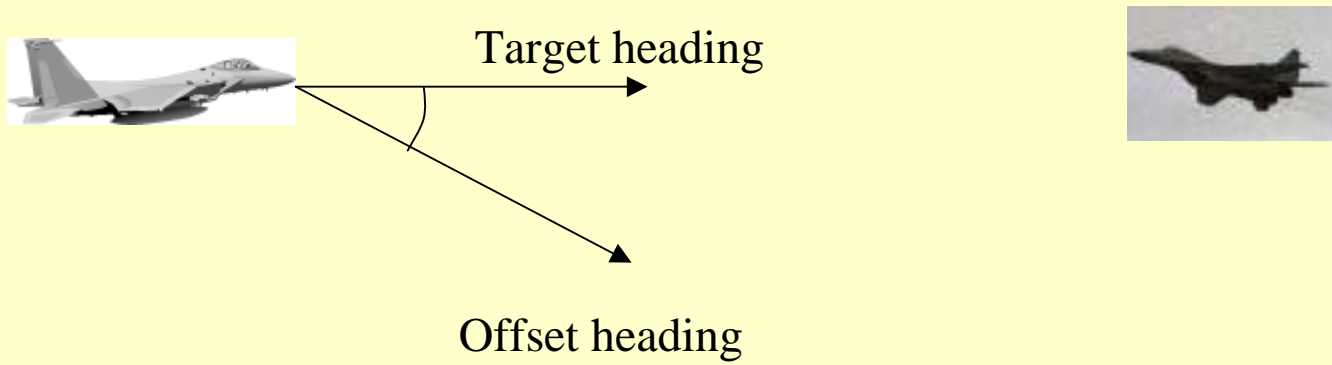


Communicate: “Range sort”

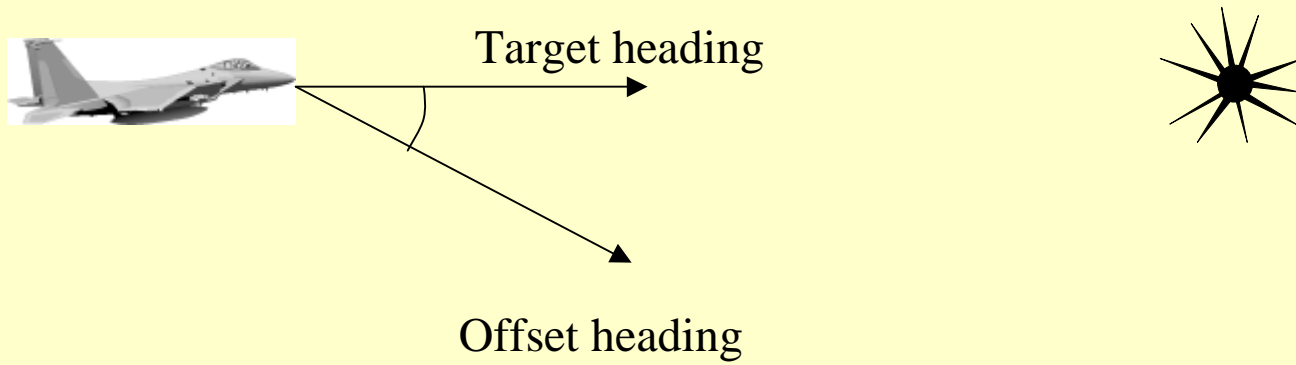
# Obsolete Information

- Attempted decisions about objects that no longer exist
  - Possible to start a goal which becomes irrelevant
- Distinct proposals and terminations
  - Termination only tested successful completion
- Proposed solution :
  - Implicit termination
  - Test for relevance *and* successful completion

# Example



# Example



# Common Sense

- Heuristic information
  - E.g., Flying planes move. Tanks don't fly.
- Too vast in scope to provide a general solution
- Domain specific approach more tractable
- Approach:
  - Goal specific knowledge
  - Progress measurement
  - Recognize failure
  - Recognize irrelevancy

# Qualitative Physics

- Interval based representations
- Typically sufficient to determine sign
  - Toward, away-from, at { + , - , 0 }
  - Position represented by regions
- Provides broad, complete domain coverage
  - May suffer from ambiguity
- Computational model
  - May be predictive

# Lump Summary

- Nuggets
  - User input validation
  - Greater user satisfaction
- Coal
  - Lack of time to dedicate to project