Cognizance, Command and Control: A Battlefield Macro and Robotic Situational Micro Systems Integrated Approach

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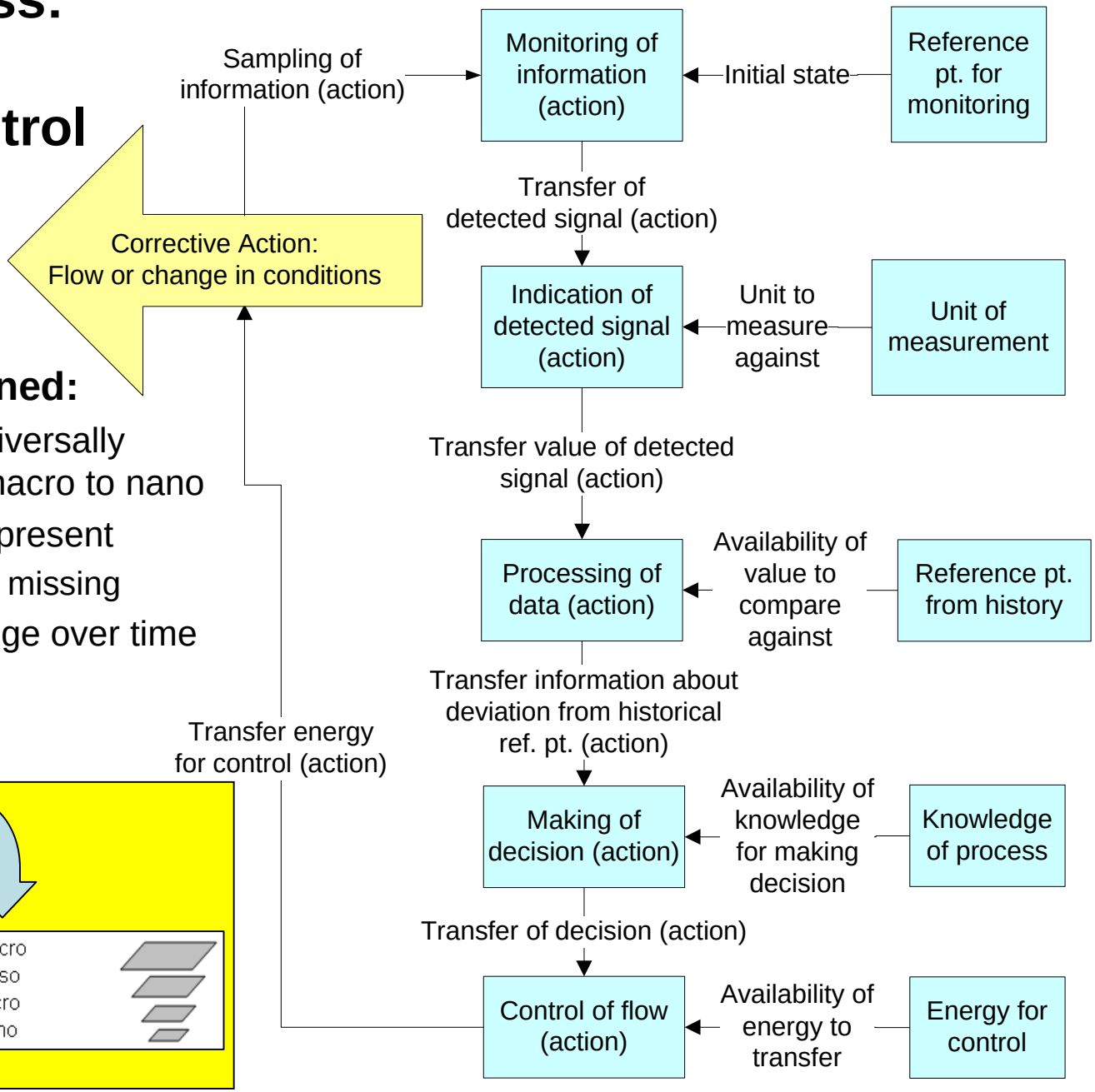
- **Objective**
  - Introduce a strategic methodology applicable to Cognizance, Command and Control (C3), for potential application, reconfigurability and upgrade, to the current family of RS JPO robots for the U.S. Army. It is intended to provide improved awareness, real time threat measurement, development of viable response options, real time sensory information and an array of battlefield options for seamless use with rules of engagement for situational combat commanders.

- **Approach**
  - The methodology will introduce a common underlying process that spans from global battlefield (macro) systems to multiple, individual, mobile, sensor enabled robotic (micro) systems. A scalable innovation model will be presented to show that the evolution of elements of cognizance, command and control is analogous to the evolution of measurement, detection and control systems, and how that knowledge can be used to accelerate response rates to changing battlefield conditions.

Discussion Points

- Underlying process: measurement, detection and control
- Evolution of base on evolutionary patterns and sequences
- Mobile multi-sensor capabilities
- Evolution of mobile multi-sensor capabilities
- Summary

Underlying Process: measurement, detection and control

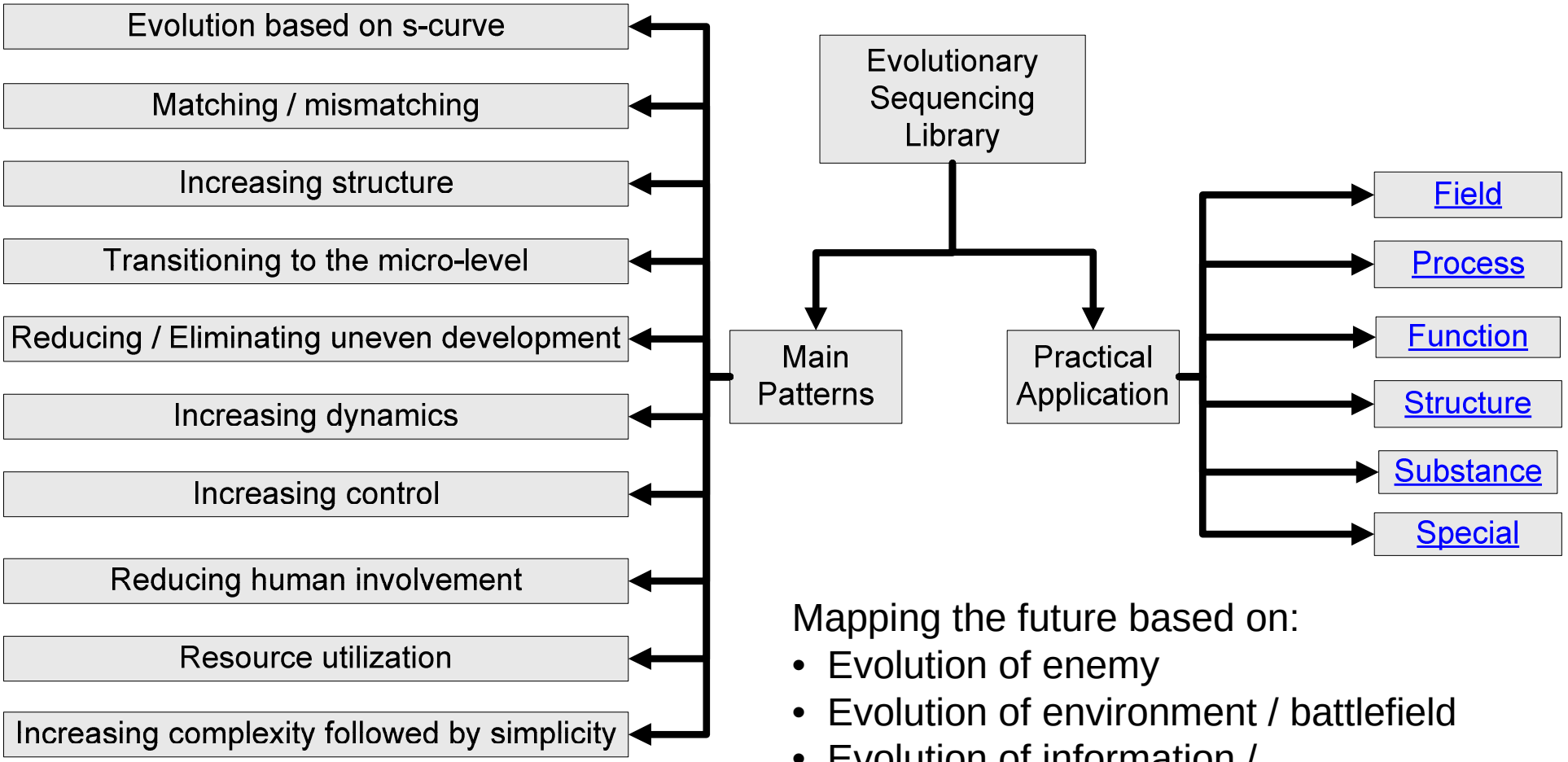


Underlying Process Defined:

- Functional description; universally applicable at all levels – macro to nano
- All functions required are present
  - Nothing extra / nothing missing
- Immutable; does not change over time
- Bounds a project

Detailed and scalable model for evolving cognizance, command and control systems from global battlefield to sensors

Evolution base on evolutionary patterns and sequences

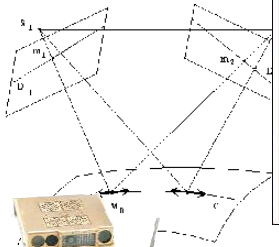


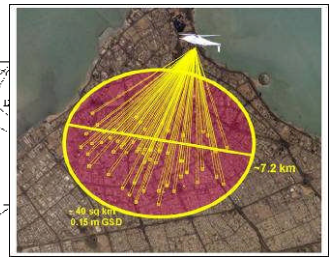
Mapping the future based on:

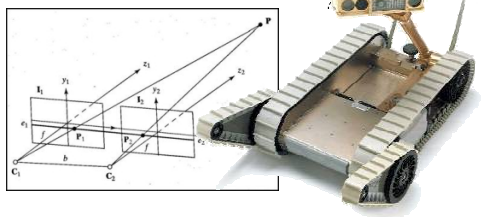
- Evolution of enemy
- Evolution of environment / battlefield
- Evolution of information / communications
- Evolution of soldier needs

Mobile multi-sensor capabilities

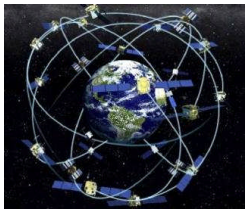
Vision Cameras

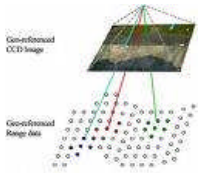


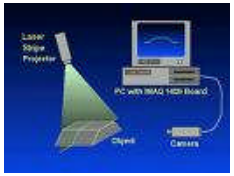


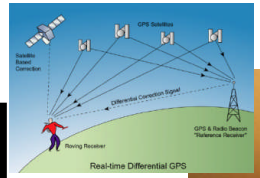


Laser, range, GPS

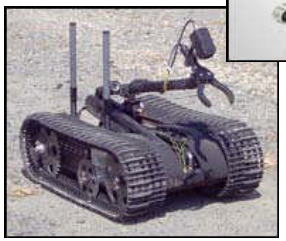




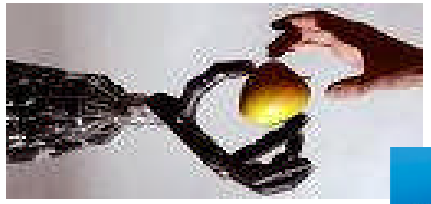


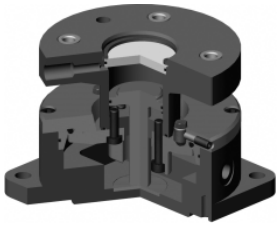


Robots

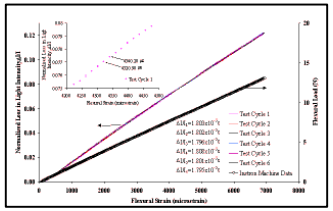


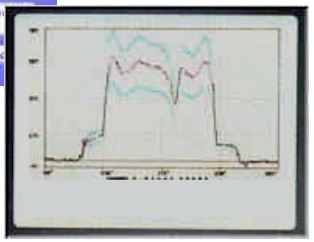
Grippers





Force Torque Sensors





Evolution of mobile multi-sensor capabilities

- Robots
  - Increased matching (to defense and environmental requirements)
  - Increased dynamics (adaptability, reconfigurability, kinematics, haptics, effectors, payloads, tool changers)
  - Increased controllability (uneven terrains, remote human interface, autonomy)
- Vision cameras
  - Increased matching (varying environmental conditions, unstructured targets, varying position and shapes)
  - Decreased human involvement (acquisition, processing, interpretation)
  - Increased complexity followed by simplification (triangulation, laser: dot / stripe / grid, point cloud, combinatorial techniques in real time)
- Laser, range, GPS
  - Increased complexity followed by simplification / increased matching / increased control (integration into other sources of data for overall cognizance and control)
- Grippers
  - Increased dynamics / controllability / matching (inter-changeability in motion)
- Force torque sensing
  - Transition to the micro-level / increased controllability / increased dynamics (increased sensitivity and adaptability in grasping unknown objects in real time)

References

- Structured Innovation Research by Applied Innovation Alliance
- Evolution of Measurement, Detection and Control Systems by Applied Innovation Alliance
- TRIZ, The Theory of Inventive Problem Solving developed by Genrich Altshuller
- Vision Guided Robotics by Advenovation
- Modular Components in Real-time Subsystems through Industry Partners