

JOINT SIMULATION SYSTEM

JSIMS

Modeling Command and Control (C2) with Collaborative Planning Agents

Randall Hill and Jonathan Gratch

University of Southern California

Information Sciences Institute

(310) 822-1511

{hill,gratch}@isi.edu

Motivation

JSIMS

- Need cost-effective ways of modeling C2 activities
 - Using human controllers to model lower C2 echelons is expensive
 - Canned scenarios are not flexible
 - A wide range of organizations and situations should be represented
- Need realistic C2 behavior
 - C2 models need to make decisions that are believable to the audience
 - The outcomes of C2 operations need to be credible

Hypotheses

JSIMS

- Realistic C2 models require *flexible group behavior*
- The key to flexible behavior is handling situation interrupts
 - Understand the nature of the situation and adjust behavior appropriately
 - Achieve goals in spite of unexpected obstacles
- Flexible *group* behavior requires the ability to:
 - Understand behavior of groups of other agents
 - Plan a mission for groups against groups
 - Execute mission plan in a coordinated manner
- Flexible group behavior interleaves the processes of situation awareness, planning, and execution
- Flexible group behavior requires *collaboration*

Research Challenges

JSIMS

- How do the goals and plans of groups of others affect my own?
- How should plans be generated for a group?
- How should a plan's execution be monitored?
- When is a plan no longer achievable?
- How can unachievable plans be repaired?
- How should planning be coordinated among C2 agents?
- How can conflicts be recognized and resolved?
- How can adversarial planning be performed?

Focus of Research

JSIMS

- **Continuous Planning**
 - Understand behavior of groups of other agents
 - ◆ Maintain situation awareness of friendly and adversarial groups
 - ◆ Recognize when a situation does not match expectations
 - Plan a mission for groups against groups
 - ◆ Collaborate with peers and superiors
 - ◆ Perform adversarial reasoning
 - Execute mission plan in a coordinated manner
 - ◆ React to situation interrupts, as a team
 - ◆ Repair plans, when necessary, and continue executing mission
- **Key Issue: Re-plan when there are situation interrupts**

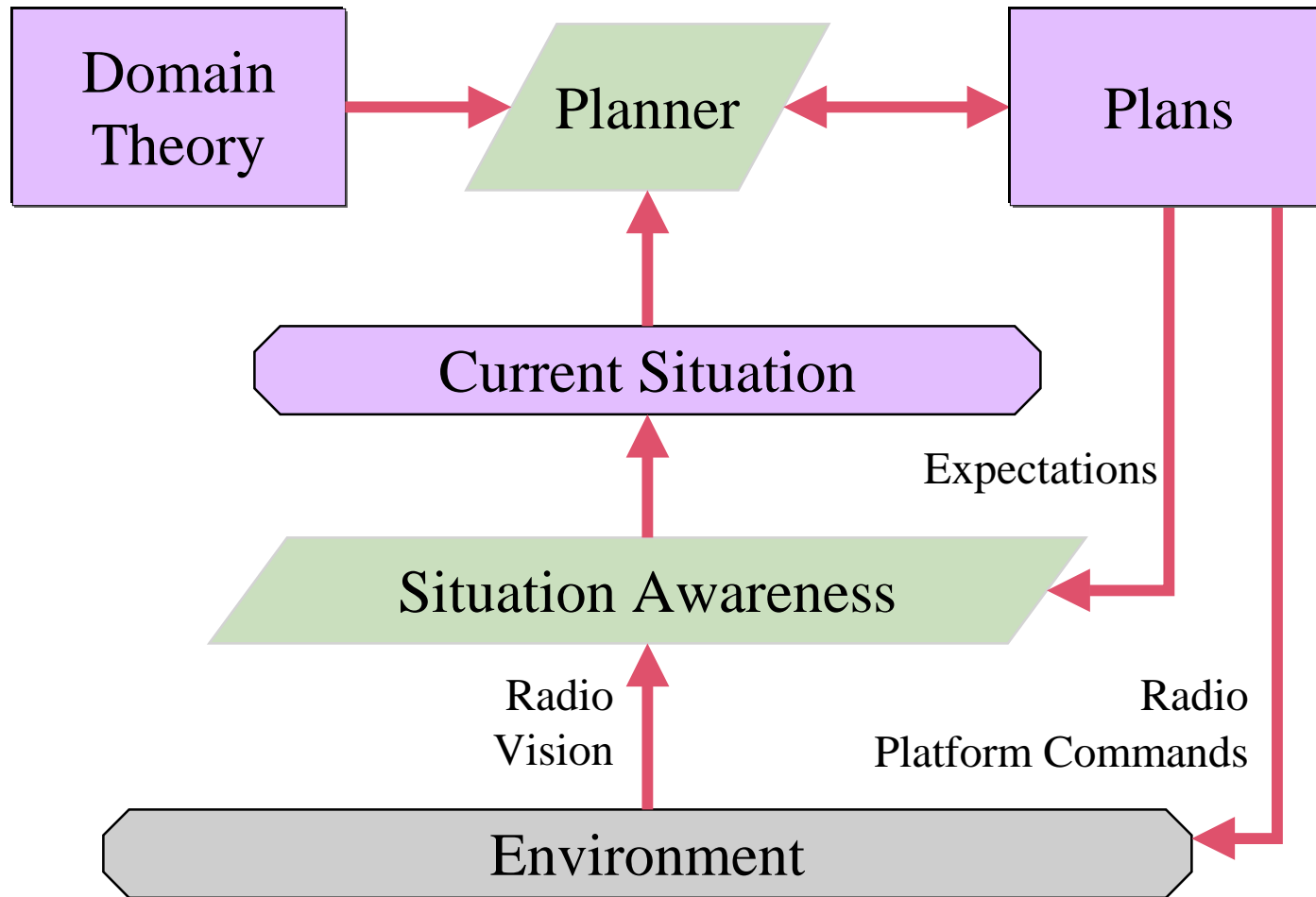
Focus of Research

JSIMS

- **Collaborative Behavior**
 - Provide a framework for understanding others' behavior
 - Address issues of authority & autonomy
 - Enable collaborative & adversarial reasoning
 - Provide a protocol for coordination and communication
- **Key issues:**
 - Represent goals and activities of other agents
 - Reason about interactions / conflicts across agents
 - Cannot treat all plans equally
 - ◆ Must understand your relationship to other agents during planning
 - ◆ Modulate behavior of planner based on these relationships

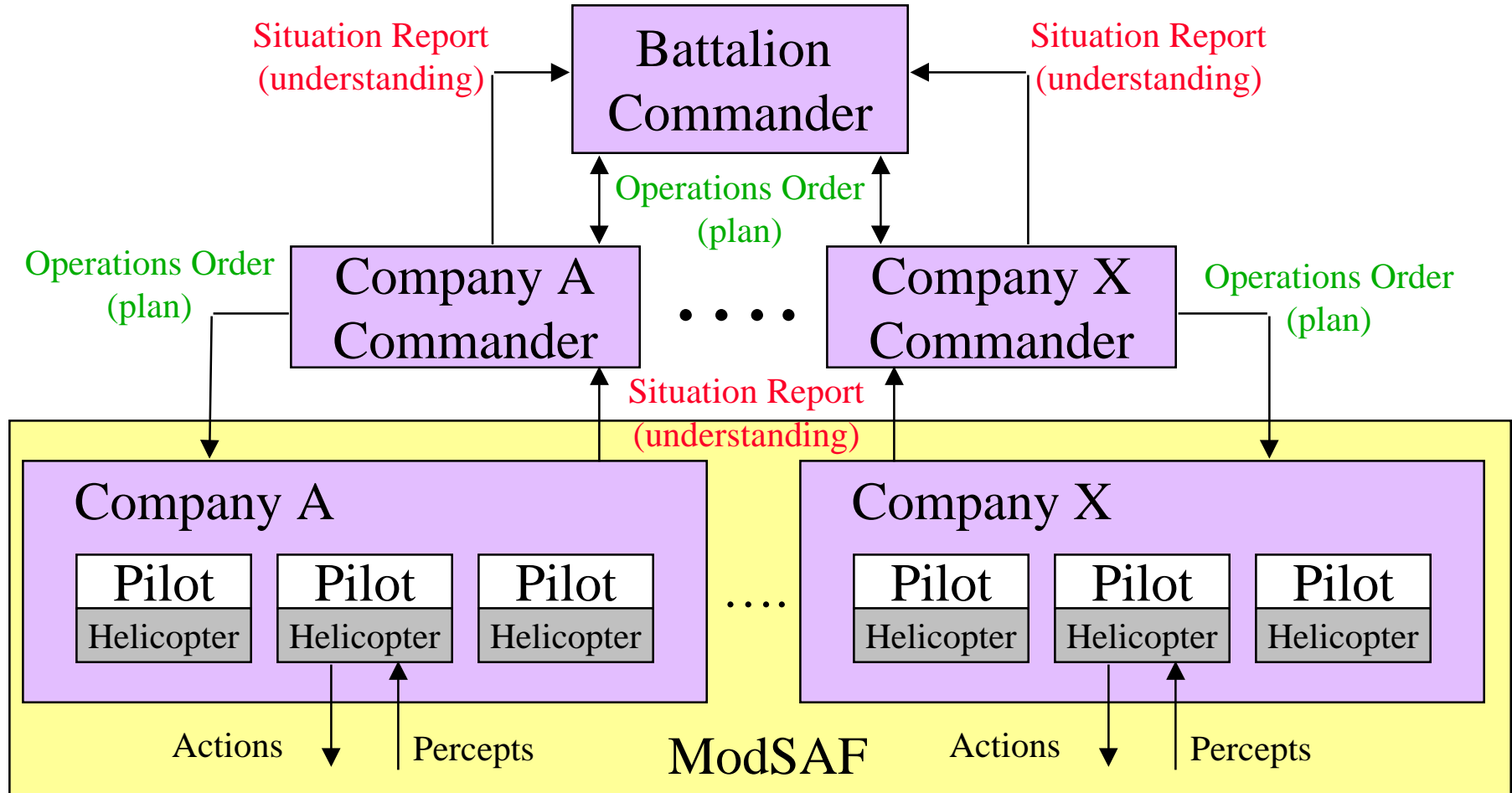
C2 Agent Architecture

JSIMS



Prototype Capabilities

JSIMS



Products

JSIMS

- C2 Agent
 - Continuous planner
 - ◆ Interleaves planning, execution, monitoring, re-planning
 - Collaborates with other C2 agents
 - ◆ Cooperate with superiors and friends, foil the enemy
- C2 knowledge base (KB)
 - Domain theory for Attack Helicopter Battalion / Company
 - Domain-independent planning and collaboration KB
- Intelligent Synthetic Forces
 - RWA-Soar pilots capable of taking direction from C2 agent

Demonstration

JSIMS

- Attack Helicopter Battalion (AH-64)
 - Battalion Commander
 - 3 Helicopter Companies
 - ◆ Company Commanders
 - ◆ Apache Pilots
 - 1 Combat Service Support Commander
- Deep Attack Mission Scenario
 - Helicopter companies move from Assembly Area to Holding Area
 - Situation interrupt occurs -- unexpected enemy forces in Holding Area
 - Dynamically re-plan and execute mission

