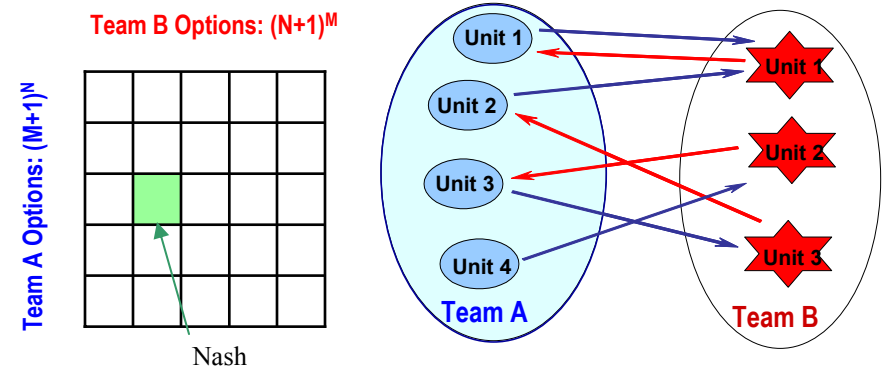


## Goals and Potential Impact if Successful

- Many systems are controlled by a team of controllers that have to operate in unfriendly and often hostile environment. Game theory provides a framework within which such systems can be analyzed and optimized.
- In this framework, the uncertainty due to the environment can be modeled as another adversarial team of controllers with objectives that are in conflict with those of the friendly team.
- The goal is to consider possible mechanisms for describing how the two teams of controllers interact, how eventually the system will evolve, and what the properties of the resulting optimized system are.
- Impact on military, economic, and possibly biological systems.



# of units Team A	# of units Team B	Size of search matrix	Size of Search Space
4	3	256 X 125	$32 \times 10^3$
8	6	5,764,801 X 531,441	$3.06 \times 10^{12}$

## Approach and/or Accomplishments

- **An attrition-based discrete time model** describing the interactions between two teams of semi-autonomous entities as they move in a two-dimensional space has been completed.
- **A game theoretic approach** assumes that the adversarial team is intelligent and may be optimizing its actions in the same way the friendly team is. The hostile team might also be using deception techniques to achieve its objectives.
- **A Nash based targeting strategy has been derived.** This strategy assigns to every entity an entity on the other side as a target. The assignment is derived in such a way that a Nash equilibrium is achieved.

## Bottlenecks and Open Research Questions

- **Adversarial intent and reasoning process:** A major problem that needs to be resolved is how to model the adversary; its intent, and its decision-making process.
- **Model and parameter uncertainties:** not necessarily due to the adversarial team need to be taken into consideration.
- **Structure of information:** In order to address the problem of implementation, assumptions need to be made on who knows what at every instant of time. This is crucial if feedback is to be used to implement the resulting controls.
- **Computational issues:** Scalability becomes an issue as the number of controllers in the system becomes large.