ENEE 769E **ADVANCED TOPICS IN CONTROL** (Game Theory: Dynamic and Evolutionary) MW 9:30am-10:45am, CSI 3118.
Instructor: P. S. Krishnaprasad (krishna@umd.edu; 301-405-6843). Office is in A.V. Williams Building – room 2233. Office Hours: M 3:30-5:30 and Tue 4:00-6:00.

This is a course on decision theory of a certain type, -- involving multiple decision makers, multiple objectives, with the objectives being in conflict/competition. The last emphasizes the non-cooperative aspects of the games we investigate. One of our aims is to present a modern treatment with reasonably complete mathematical proofs of the foundations of static games. Nearly contemporaneous with the new ideas that Nash introduced in the early 1950's, was the introduction by Isaacs of the fundamentals of differential games. These have played a key role in the development of control theory and applications. We will present a concise treatment of linear differential games with quadratic costs. We will then present the general results in this area with outlines of proofs. A third and very active development is the area of evolutionary games, first spearheaded by biologists (beginning with the work of Maynard Smith and Price in 1973), and now intensely studied by economists. This area has seen flowering of a dynamical systems viewpoint already present in the algorithmic investigations of von Neumann and Brown, and hinted at by two interpretive paragraphs in Nash's thesis.

The developments in game theory in all the directions we have mentioned above have had wide-ranging applications. Newer applications to networked systems, auctions and other economic contexts have stimulated many interesting advances in the theory.

Topic Outline
1. Fundamentals (static games)
Normal form, Equilibrium, Refinements, Extensive Form, and Fixed Point Theorems.
2. Evolutionary Games
Evolutionary stability, Replicator dynamics, connections to Nash equilibrium.
3. Differential Games
Linear systems with quadratic costs, necessary conditions for optimality, Isaacs' contributions.
4. Applications
Networked systems, robustness, pursuit-evasion, population biology, some simple economic applications.

The course will use a variety of sources, including:
1. Course notes by instructor
2. Tamer Basar and Geert Jan Olsder – Dynamic Noncooperative Game Theory, SIAM (1995/1999).
3. Joergen W. Weibull – Evolutionary Game Theory, MIT Press, 1995.

Grading: Midterm exam (October 20), Term paper.