The purpose of this EE599 course will be to introduce students to the emerging field of “Network Control,” which includes four major themes:

1) The idea of making the throughput better by active control around the routers (Active Queue Management (AQM), Random Early Drop (RED)).
2) The idea of using alternate paths to decongest some “bottleneck” links in a feedback scheme.
3) The idea of using feedback defense strategies to slow down the propagation of worms.
4) The problem of using the network infrastructure to do “control at a distance,” also referred to as “Networked Control,” that is, when the controller and the plant are at different geographical locations with both the sensing and control signals being transmitted via the network under TCP or UDP.

The above program might be fine tuned and refocused depending on students’ interests. We will attempt to make the course as self-sufficient as possible, by reviewing the fundamental concepts of signal processing, control, graph theory, and networking.

**Format**

This course will be entirely research oriented and the letter grade will be decided on “mini-projects” (10%) assigned in the course of the semester and a more substantial “term project” (90%) of a subject of the student’s choice, but relevant to the course material and subject to instructor’s approval. The students will be allowed, and will be encouraged, to build their “term project” on the mini-projects.

**Course Material**

As this is a topic at the “cutting edge,” this is not as yet a formal textbook that would cover the course material. However, the instructor will post relevant articles, papers, handouts, etc. on the Black-Board. Here are some samples of relevant reading material:


Pdf files of the above papers and other relevant reading material can be found in [http://eudoxus.usc.edu/CHAOS/traffic.html](http://eudoxus.usc.edu/CHAOS/traffic.html) and [http://eudoxus.usc.edu/IW/AIA.html](http://eudoxus.usc.edu/IW/AIA.html).

**Course Schedule**

<table>
<thead>
<tr>
<th>January 2004</th>
<th>Introduction to networks, physical graphs, logical graphs, route discovery (Bellman-Ford, Dijkstra’s algorithms), TCP, queuing theory.</th>
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<tr>
<td>February 2004</td>
<td>Introduction to link utilization signal processing and identification: canonical correlation analysis, innovation models, ARMA models, Minimum Length Description (MLD), Akaike’s Information Criterion (AIC). Identification of TCP dynamics, general introduction to feedback control, and applications to Active Queue Management (AQM).</td>
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<tr>
<td>March 2004</td>
<td>More advanced control applications (here some choices will have to be made depending on students’ interests): Intrusion detection and defense strategies in a feedback scheme; Worm detection and defense; feedback selection of alternate paths and the fluttering problem as a feedback instability; reduction of fluttering on a hyperbolic network.</td>
</tr>
<tr>
<td>April 2004</td>
<td>Networked control: time reference, delay tolerance, UDP versus TCP, data flow architecture.</td>
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