2.004 Dynamics and Control II
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Massachusetts Institute of Technology

Department of Mechanical Engineering

2.004 *Dynamics and Control II*

Lab Description and Rules

Introduction: This handout describes the major components of the components of the 2.004 laboratory work stations.

Computer: The computer is a Micron 2.2 GHz PC with 1 Gbyte of RAM, and 40 Gbytes of hard disk. The computers are configured as part of the ME domain, and share a networked printer in the laboratory. Each computer contains a National Instruments M-series PCI-6221 high performance data acquisition and control card, that allows sampling of 16 channels of 16 bit data, at sampling rates up to 250 ksamples/sec. The cards have two digital-analog converters (DAC). This board also has digital input and output capability, although we will not use these features in 2.004. Communication with the computer is via a BNC terminal box (National Instruments BNC-2090).

The operating system is Windows XP Pro (SP 2). The computers are deliberately kept in a "locked-down" state. You will be given access to all of the resources necessary to complete the labs, but you will not be able to make customizations or modifications to the operating system.

Logging on to the Computers: The 2.004 computers are configured as part of the Mechanical Engineering domain. Each lab group will have an account for this course. Your home directory will appear as drive z:. Your account, and any files you create during the lab, will be accessible from any Mechanical Engineering computer.

Software: The following software packages are installed and available for use:

- Microsoft Office 2003, including Microsoft Word, Excel, Access, PowerPoint.
- Internet Explorer 6
- Matlab 7.0, including Simulink and the following toolboxes: Control Systems, Signal Processing, System Identification, Nonlinear Control, Robust Control, Optimization, Wavelet, Partial Differential Equations and StateFlow.
- Maple 9.5 or 10.
- National Instruments LabVIEW 8.0 Professional, with full development facilities and all toolkits.
- National Instruments Signal Express.

In addition there are a set of specialized software packages developed for 2.004, including a set of virtual instruments (a computer based chart recorder, a spectrum analyzer, and a set of digital controllers) written in LabVIEW 8.0.

Laboratory Hardware: The following instrumentation is provided at each work-station.

- Oscilloscope A Tektronix TMS-3020 digital oscilloscope is provided. This is a high quality oscilloscope, and is available for testing and debugging hardware, Most of the experimentation will be based upon the use of "virtual", or computer-based instrumentation, and the oscilloscope will not generally part of the required equipment.

- Function Generator A Sony/Tektronix arbitrary function generator will be used to define set-points, and trajectories for your control system experiments. This unit can generate sinusoids, square waves, pulses, triangular and sawtooth waves, random noise, etc over a very broad range of frequencies. This is a high quality instrument, and your lab instructor will show you how to use it.

- Power Supply: You are provided an instrumentation quality power supply (Tektronix) that can be used as a reference input or to power external equipment.

- Servo motor Power amplifier The servo power amplifier contains an Aerotech 4020-LS linear power amplifier configured in a VCCS (voltage controlled current source) mode. The ratings of this amplifier are output voltage of ± 40 volt, and a peak current of ± 20 amps (for less than 2 seconds), and a sustained maximum current of ± 5 amps. The internal amplifier has been modified slightly to reduce its gain, and calibrated to a gain of 2 amp/volt. Internal buffered amplifiers have been installed to monitor the load voltage and current.

- "Proto" Boards In some of the experiments you will be required to build analog controllers using electronic operational amplifiers. Each lab group will be given a proto board on which to construct their circuits. The board can be stored from week-to-week. Each lab-station will have a power supply to operate the boards.

Insert one or more photos of the lab stations here

Laboratory Rules

In the interests of safety, security, and to minimize the risk of damage to the equipment we must insist that the following rules be observed:

- Unsupervised student access to the laboratory is not allowed. There must be present a faculty member, teaching assistant, or a designated supervisor at all times,
- No equipment or components are to be removed from the laboratory at any time. This includes a ban on all lending of equipment to research groups.
- No external equipment (other than that provided within the laboratory) is to be connected to the computers or power amplifiers without the express permission of the faculty member in charge.
- Missing equipment or components must be reported immediately to the laboratory supervisor. Otherwise you may be blamed for the loss of equipment. It is suggested that you do a quick inventory of the major items at the start of each session.
- The laboratory work area is to be left clean and tidy at the end of each session. Cables and components must be returned to their drawers and racks, all unwanted/damaged components should be placed in the trash cans, and the desk left clean and neat.
- No software is to be installed on any of the lab computers without the express permission of the faculty member in charge.
- The computer configuration (software and hardware) is not to be changed except through icons provided on the desktop. The "control panel" may not be used to change the configuration, and under no circumstances should the BIOS setup be invoked.