

## ME 4710 Motion and Control

### Introduction to System Identification

- *System identification* (ID) is the process of *developing* a *quantitative numerical model* from a set of input and output data that represents the response of a dynamic system. For this reason, it is necessary for the recording of the *input* and *output* data be *synchronous*.
- The system ID process is *not strictly* a *numerical process* of finding the model that best matches the response data. For the resulting model to be useful in the compensator design process, it must *capture* the *essential physics* of the system.
- The system ID process can be broken into the following *basic steps*:
  - Determine the most *appropriate input* (excitation) for the system.
  - *Collect* multiple sets of input-output data. *Averaging* and/or *filtering* (e.g. anti-aliasing filters) can be used to minimize the effects of system variability, noise, and errors associated with sampling data.
  - Modify the data as necessary before searching for the best model to represent the data. Be careful *not to alter* the *basic character* of the data.
  - Define the *form* of the *model* to match the physics of the system, if possible.
  - Compute the *best-fit parameters* for a model of this form.
  - Use the model to predict system response to verify that it provides physically realistic results.
  - If the model-predicted system results are not considered to be representative of the system, try again with another form of model.
- Two typical types of data are used for the system ID process, *time-response*, or *frequency-response* data.
- *Time-response data* is simply a pair of input-output synchronized time histories. The time histories are usually sampled at a fixed sampling rate that is fast enough to capture the highest frequencies present in the data.
- *Frequency-response data* may be simply Fast Fourier Transforms (FFTs) of time histories or it may be in the form of a *Bode diagram*, giving the magnitude and phase of the harmonic response of the system.