# 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 important that 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.