

**EE302 Controls**  
**Finding a Transfer Function via Block Reduction**  
**DePiero**

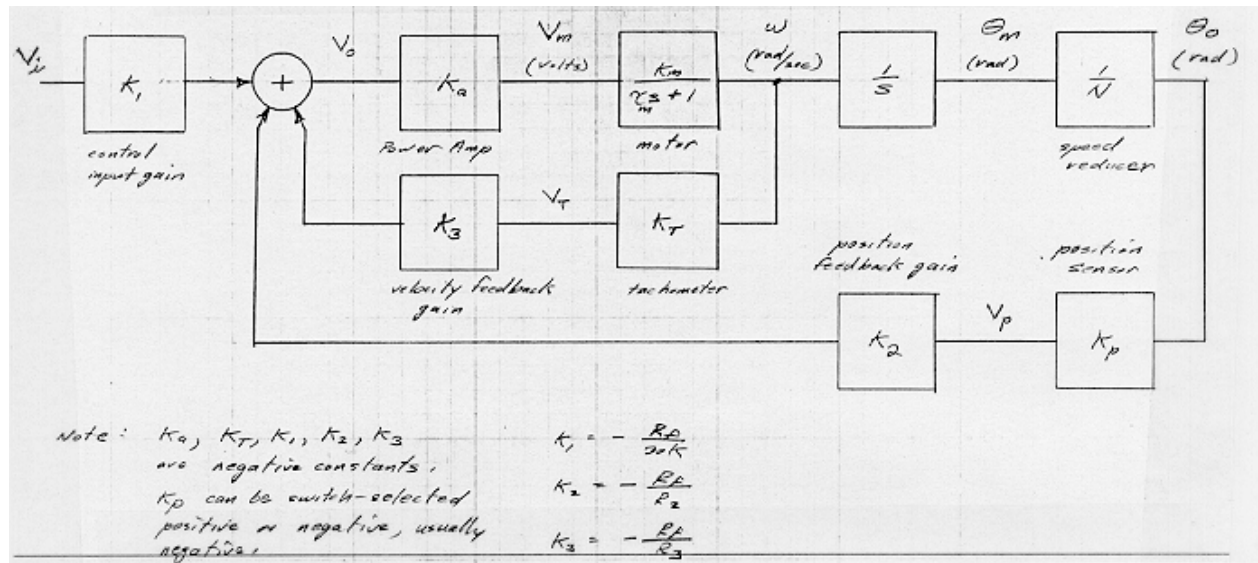
**Goal:** Find a transfer function,  $T(s)=Y(s)/R(s)$ , given a relatively complex block diagram representation.  $T(s)$  is useful for analysis purposes (step response, rise time...).

**Problem:** Sometimes block diagrams of control systems can be rather complex; despite this we still may desire an overall transfer function. See the figure below (from lab).

**Approach:** 'Block Reduction' is a process of adding, rearranging, and combining blocks to eventually simplify the overall block structure. Generally as blocks are combined, the topology of the structure becomes simpler while the transfer function within a given block becomes more complex. Via step-by-step changes the system may be reduced to a single block that contains  $T(s)$ .

See Table 2.6 in the Dorf text for a table of block reductions (also on Blackboard).

There is no established guide to the order of the step-by-step changes... *Good Luck!*



Block diagram of the MotoMatic (from EE342 Lab Manual, Prof MacCarley).  
 This system can be readily simplified, after a block reduction step...