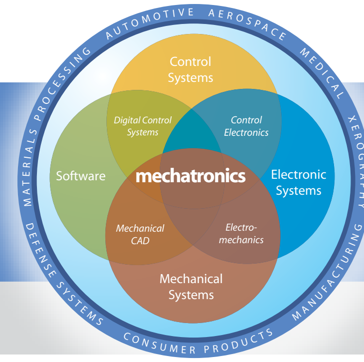
MECHATRONICS IN DESIGN

FRESH IDEAS ON INTEGRATING MECHANICAL SYSTEMS, ELECTRONICS, CONTROL SYSTEMS AND SOFTWARE

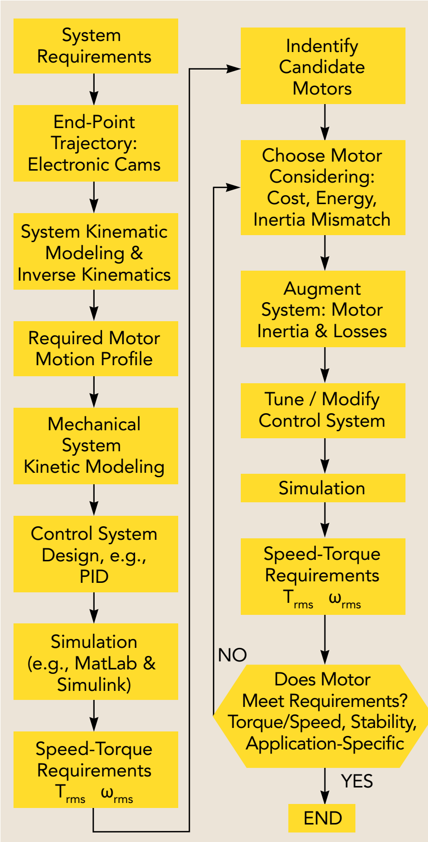


Modeling and Simulation for Motor Selection

Why trajectory planning, system modeling and control design are essential.

MULTIDISCIPLINARY ENGINEERING systems are complex and carry increased risk, development time and integration challenges. Model-based system design helps to manage the complexity and enhance integration while reducing the development time and risk. But just how does model-based design improve the process of choosing a motor for a motion application?

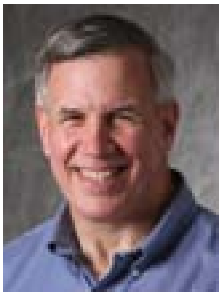
First of all, consider that system requirements dictate a desired end-point trajectory. The motion can be defined as an electronic cam, characterized by different profiles and maximum values of velocity, acceleration and jerk, which will affect the level of mechanical stress, vibration and noise in the motor, transmission system and mechanical load. It is therefore essential that the desired motion profile be chosen first, because the required torque versus speed curve to size of the motor depends on it. In addition, the motion profile has relevant implications on the tracking errors through the control system. A kinematic (geometry of motion) model of the mechanical system is then developed and, through inverse kinematics, the required motor motion profile is determined. The torque-speed requirements for the motor are determined by first developing a kinetic (geometry plus all torques and mass moments of inertia) model of the complete mechanical system and then applying an appropriate feedback control system (e.g., PID) to that model. A computer simulation (e.g., MatLab Simulink) of the mechanical and control systems will result in the necessary torque-speed curve of the load to size the motor.



Once this process is complete, candidate servo motors (e.g., permanent-magnet synchronous motors) can be identified. Additional requirements, such as cost, energy efficiency and load-to-motor inertia ratio, will shorten the list. The chosen motor, including any flexible couplings or gearing, becomes an integral part of the system, and its properties must be included in the system model. The control system will have to be tuned or even modified because of the motor addition.

A computer simulation will reveal new torque-speed requirements for the system by presenting a number of issues to address. Is the motor's torque-speed capability satisfactory? Is the control system stable? Does the system meet application-specific requirements regarding time response, relative stability and steady-state error? If the answer to any of these questions is no, iteration is required.

With all of these factors addressed in detail, a model-based design approach, together with computer simulation, can lead to optimal motor selection and all the benefits that implies to overall system performance. **DN**



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