ME451
Kinematics and Dynamics of Machine Systems

Dynamics of Planar Systems

November 17, 2011

Finish 6.3

"To improve is to change; to be perfect is to change often."
Winston Churchill

Before we get started…

- Last Time
  - Looked at the contribution to the EOM of an external force or torque that is applied at a point P (how to get a generalized force Q^A)
    - Discussions of TSDA & RSDA
  - Started discussion about how to get the EOM for a set of bodies (a mechanism)

- Today:
  - Wrap up EOM discussion after we introduce the Lagrange Multiplier Theorem
    - Example: EOM for a slider-crank mechanism
  - Discuss why and how to specify Initial Conditions (ICs)
    - Example: Pendulum, setting a set of ICs

- HW due Tuesday, Nov 29:
    - 6.1.1 thru 6.1.4, and 6.2.1
    - MATLAB component will be emailed to you

- NOTE: Syllabus has been updated, we'll discuss on Tu

Getting Rid of the Internal Forces: Summary

- **Our Goal**: Get rid of the constraint forces $\mathbf{Q}^C$ since we don't know them

- For this, we had to compromise…
  - We gave up our requirement that $\delta\mathbf{q}^T[\mathbf{M}\ddot{\mathbf{q}} - \mathbf{Q}] = 0$ holds for **any arbitrary virtual displacement**
  - Instead, by only selecting **virtual displacements δq that are consistent with the set of constraints** present in the system, we saw that we can get rid of $\mathbf{Q}^C$:

$$\delta\mathbf{q}^T[\mathbf{M}\ddot{\mathbf{q}} - \mathbf{Q}^A] = 0$$

…whenever…

$$\mathbf{\Phi_q}\delta\mathbf{q} = \mathbf{0}$$

NOMENCLATURE: Constrained Variational Equations of Motion

This is the condition that it takes for a virtual displacement q to be consistent with the set of constraints