Dynamics of Rigid Bodies
Methods of Solutions
General Plane Motion

• Vector Method
  Relative motion between two points
  Common point on two rigid bodies
  Resolving vector equation into x and y equations

• Geometric Method
  Figure from triangular and other positions of linkages
  Using Law of Sines and Cosines, etc.

• Instantaneous Center of Zero Velocity (IC)
  Reducing general plane motion into simple rotation

• Force, Moment and Acceleration Method
  Newton’s laws of motion in translation and rotation

• Work and Energy
  Conservation of Energy

• Impulse and Momentum
  Conservation of Linear Momentum
  Conservation of Angular Momentum
Instantaneous Center of Zero Velocity (I.C.)

- At any instant in time, it is possible to find a point on a rigid body in general plane motion that has zero velocity.

- A and B are any two points on a rigid body whose velocities are known. The intersection of lines perpendicular to these velocities locate the I.C. of zero velocity.

\[
\begin{align*}
    v_C &= 0 \\
    \vec{v}_A &= \vec{v}_C + \vec{v}_{A/C} = \vec{v}_{A/C} \\
    &= \omega \hat{k} \times \vec{r}_{A/C}
\end{align*}
\]

\[
\begin{align*}
    \vec{v}_B &= \vec{v}_C + \vec{v}_{B/C} = \vec{v}_{B/C} \\
    &= \omega \hat{k} \times \vec{r}_{B/C}
\end{align*}
\]

- For \( v_A \) and \( v_B \) parallel but opposite, the I.C. lies between the velocities.

- For \( v_A \) and \( v_B \) parallel and in the same direction, the I.C. lies either above or below the velocities in accordance with their magnitudes.

\[
\begin{align*}
    \omega &= \frac{v_A}{r_{A/C}} = \frac{v_B}{r_{B/C}} \\
    r_{A/C} - r_{B/C} &= r_{A'C'}
\end{align*}
\]