Kinematics Concept Map and Relationships

TCB

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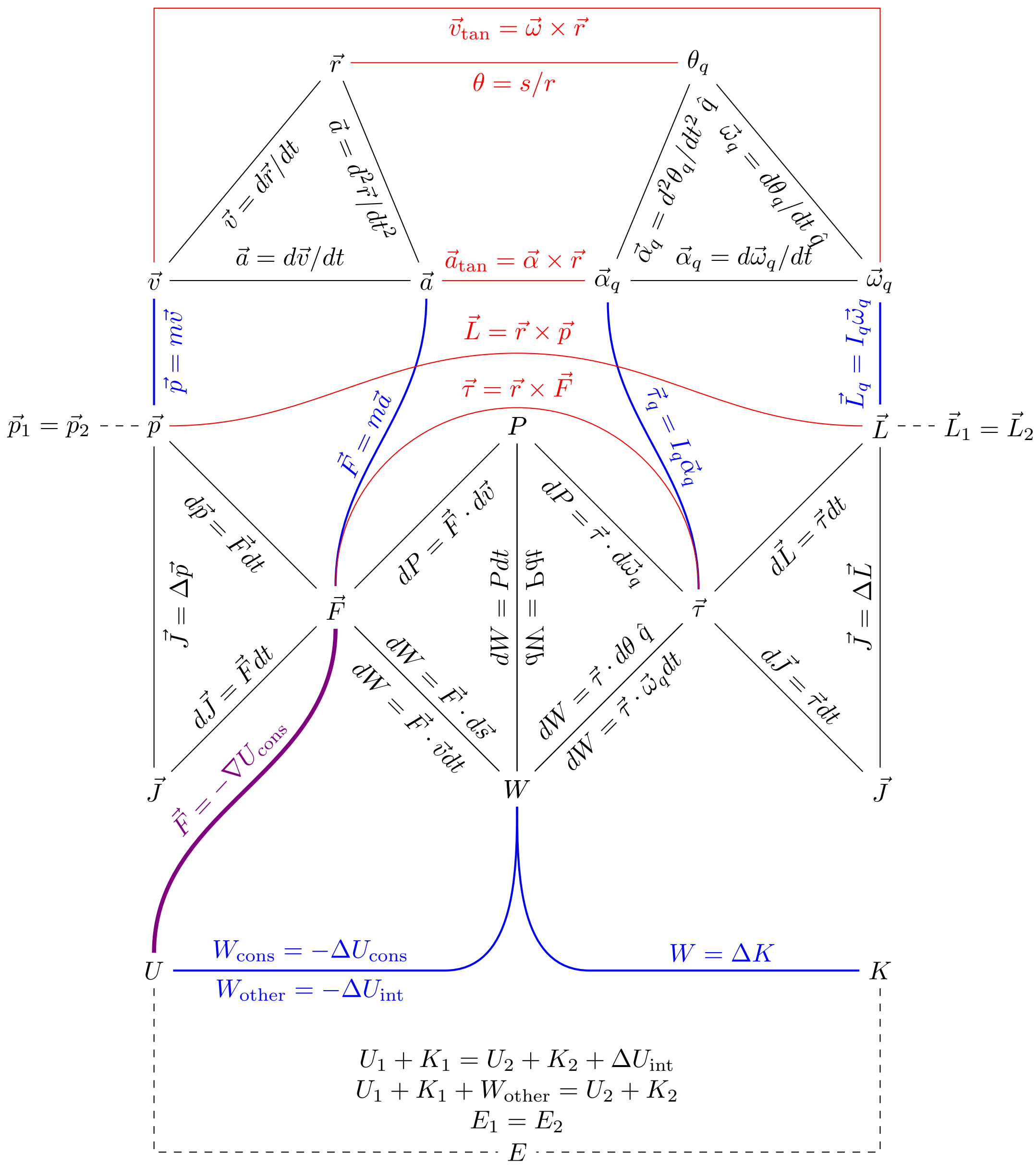

Main concepts in translational (left hand) and rotational (right hand) motion are nodes in the network. The concepts are collected by category as descriptors (top), dynamics (middle), and energy (bottom). Work, energy, and power are common between translational and rotational motion. Connections between concepts are edges that are labeled with their mathematical relationships. Those in blue represent inter-category relations within each type of motion and those in red represent connections between linear and angular motion. The purple edge is the special relation between force and potential energy. Dashed edges indicate conservation laws.

Linear (Translational)		Angular (Rotational)	
t	time	t	time
$\vec{r}$	position	θ_q	angular position around axis q
$\vec{v}$	velocity	$\vec{\omega}_q$	angular velocity around axis q
$\vec{a}$	acceleration	$\vec{\alpha}_q$	angular acceleration around axis q
m	mass	I_q	moment of inertia about axis q
$\vec{p}$	momentum	$\vec{L}$	angular momentum
$\vec{F}$	force	$\vec{\tau}$	torque

P	power
$\vec{J}$	impulse
W	work
U	potential energy
K	kinetic energy
U_{cons}	potential due to conservative interactions
W_{cons}	work done by conservative interactions
U_{int}	internal energy
W_{other}	work done by interactions not accounted for explicitly
E	total energy
q	generic variable for discussion of operations
Δq	difference between final and initial values of q ($\Delta q \equiv q_{\text{final}} - q_{\text{initial}}$)
dq	differential element q
$\hat{n}$	unit normal vector to the plane defined by q_1 and q_2; direction defined by right-hand rule
$\vec{q}_1 \cdot \vec{q}_2$	scalar (dot) product between q_1 and q_2 ($\vec{q}_1 \cdot \vec{q}_2 = \|\vec{q}_1\|\|\vec{q}_2\| \cos(\phi_{1,2})$)
$\vec{q}_1 \times \vec{q}_2$	vector product between q_1 and q_2 ($\vec{q}_1 \times \vec{q}_2 = \|\vec{q}_1\|\|\vec{q}_2\| \sin(\phi_{1,2})\ \hat{n}$)