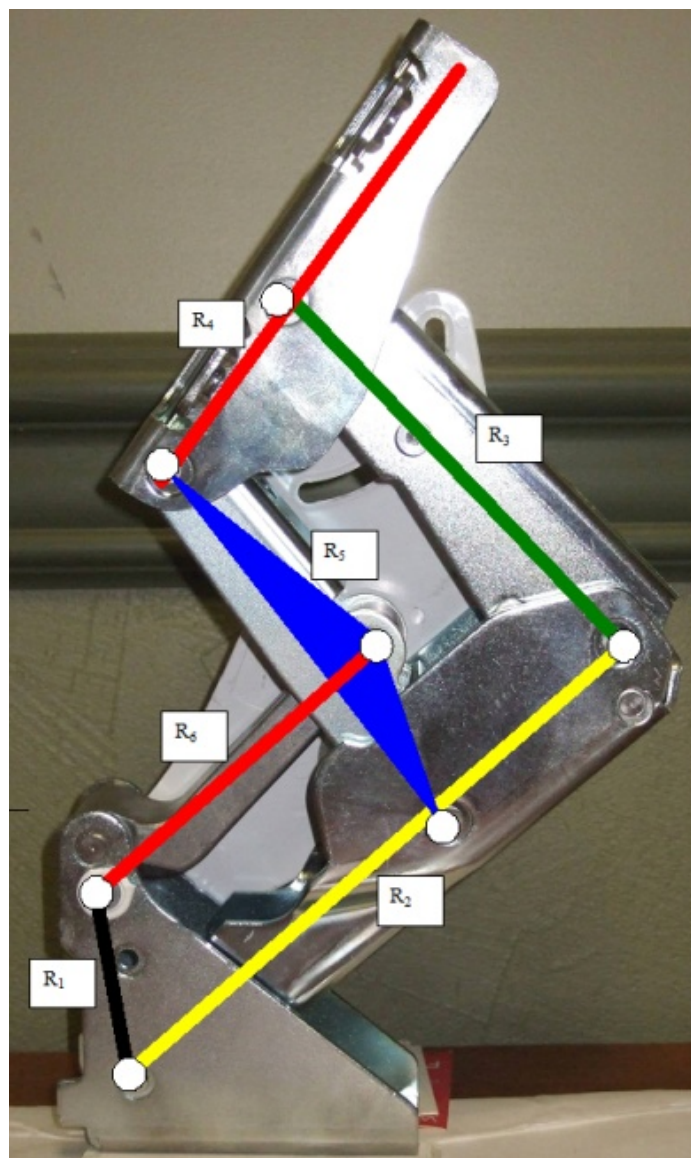


# An Atlas of Structures, Mechanisms, and Robots

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Mechanical Engineering, Ohio University

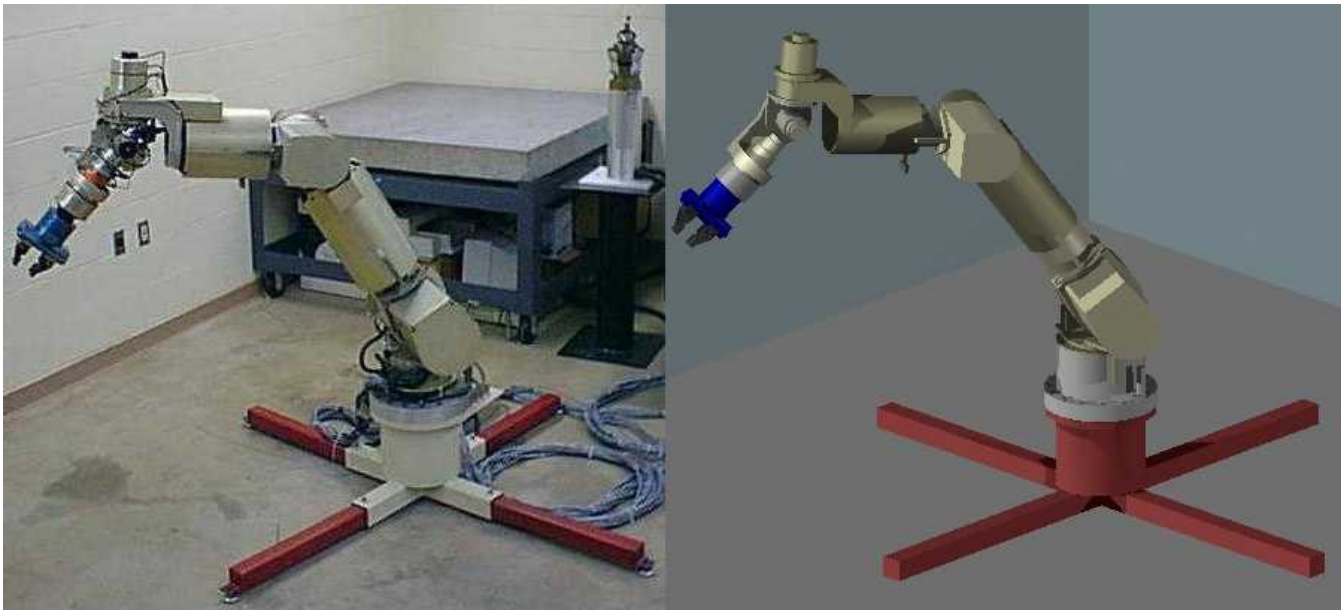
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Hettich Hinge Watt I 6-bar Mechanism

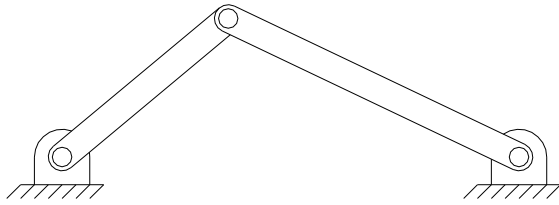
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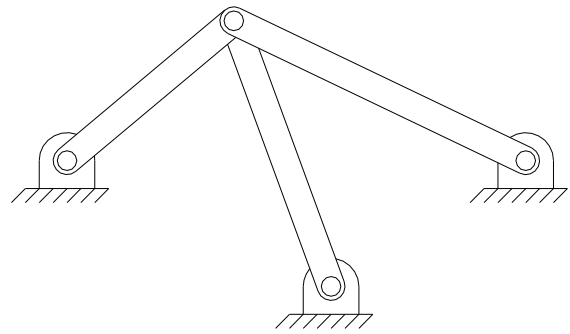


**NASA 8-dof ARMII Robot**

## Zero-dof (or less) Structures

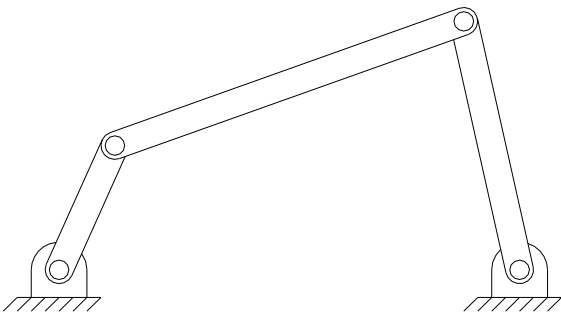


**Statically Determinate Structure**

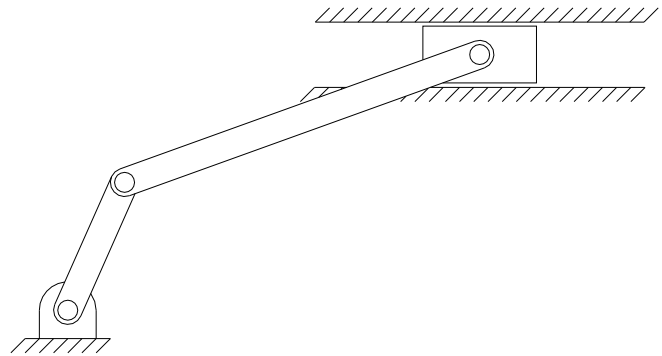


**Statically Indeterminate Structure**

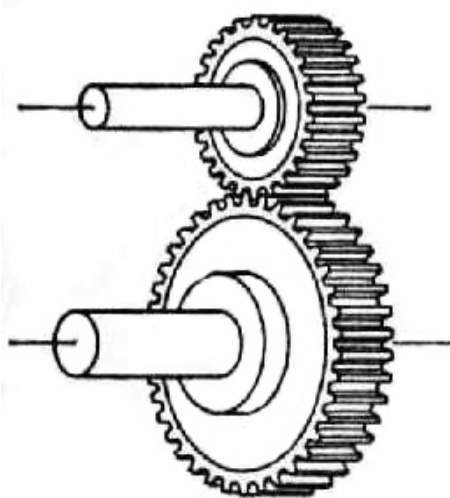
## One-dof Mechanisms



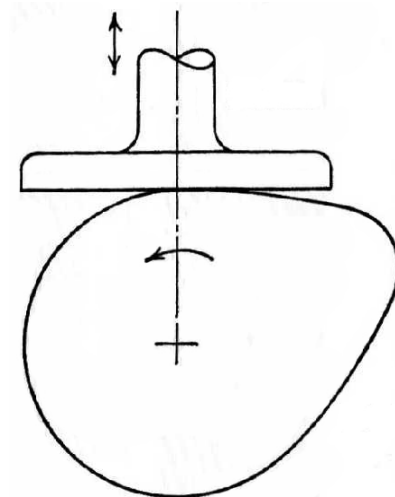
**4-Bar Mechanism**



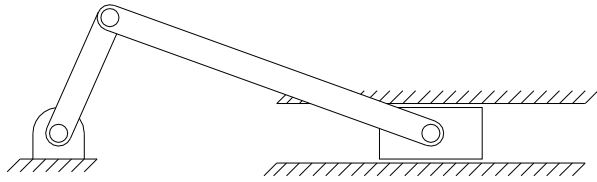
**Offset Slider-Crank Mechanism**



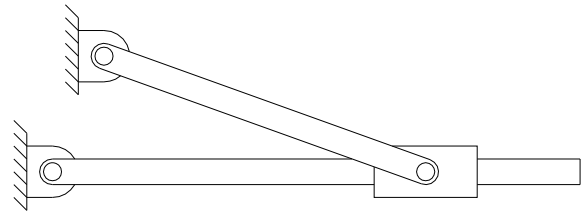
**Spur Gear Mechanism**



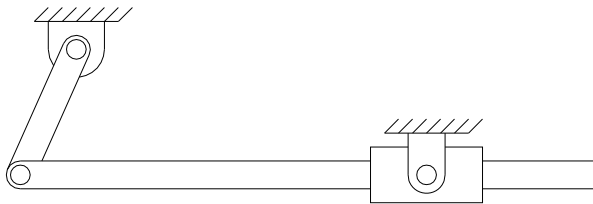
**Cam-and-Follower Mechanism**



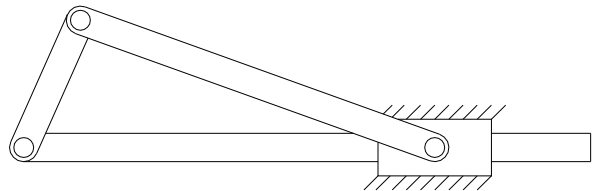
**Slider-Crank Mechanism Inversion 1**



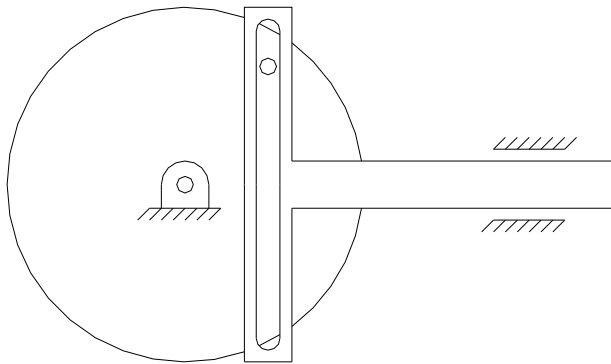
**Slider-Crank Mechanism Inversion 2**



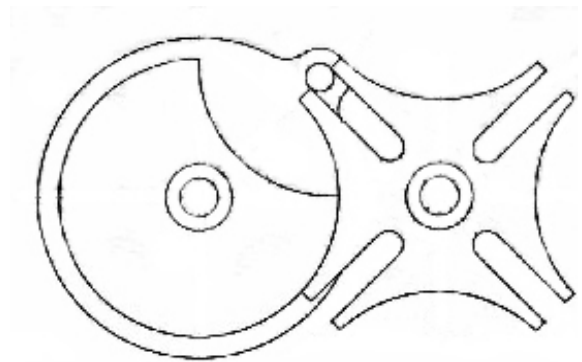
**Slider-Crank Mechanism Inversion 3**



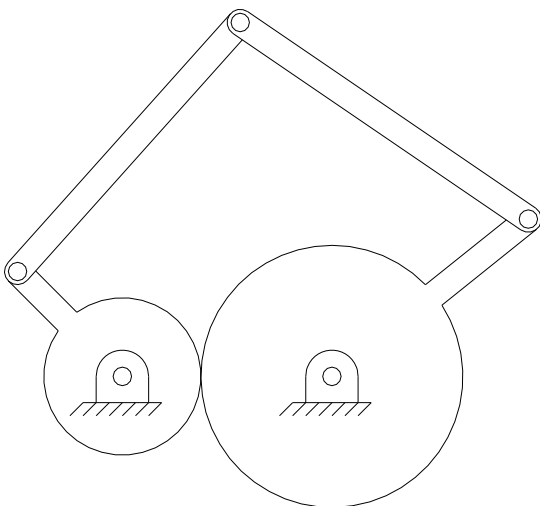
**Slider-Crank Mechanism Inversion 4**



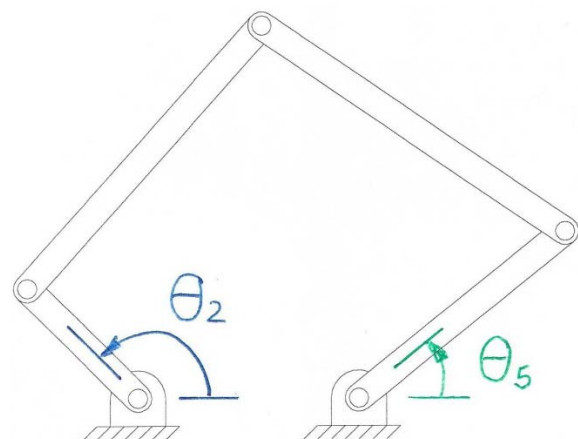
**Scotch-Yoke Mechanism**



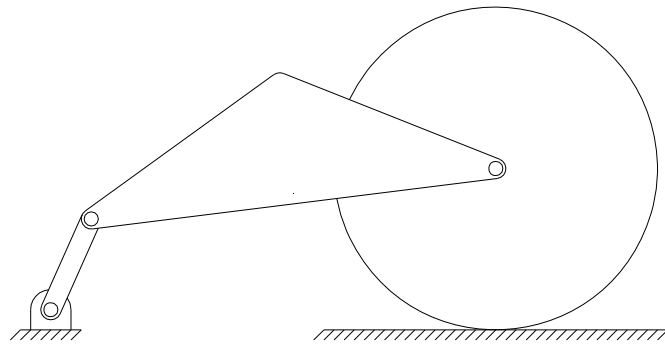
**Geneva Wheel Mechanism**



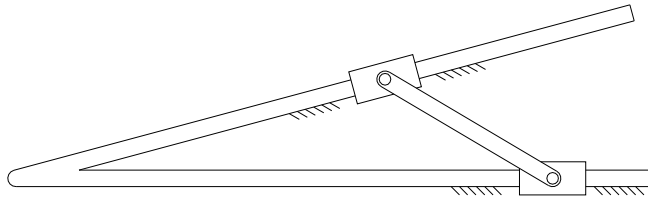
**Geared 5-Bar Mechanism**



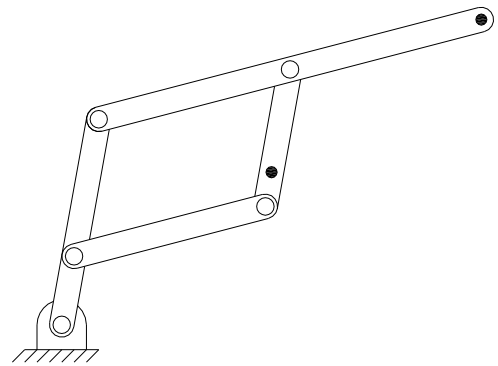
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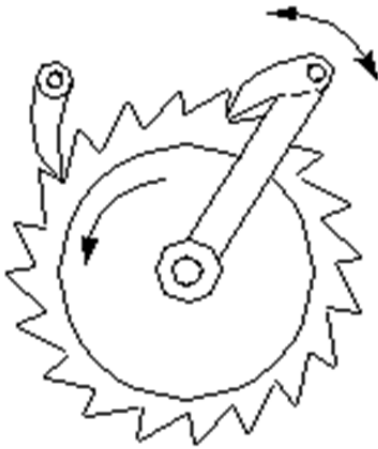
**4-Bar Rolling Mechanism**



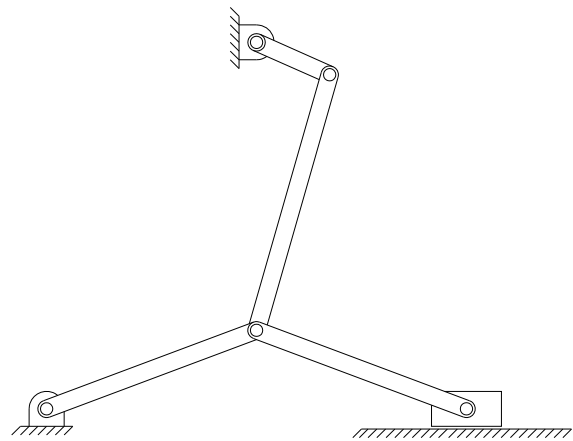
**Dual-Slider Mechanism**



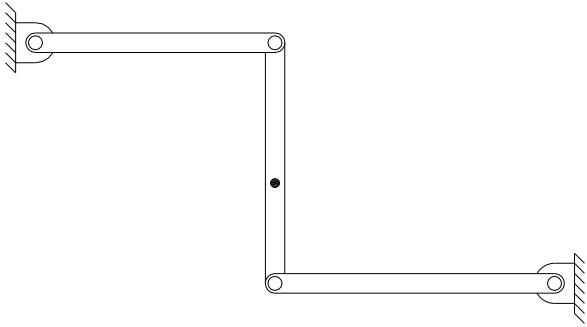
**Pantograph Robot**



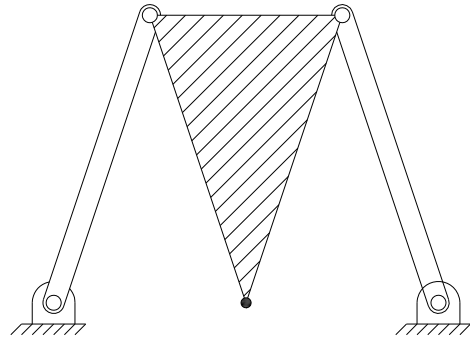
**Ratchet Mechanism**



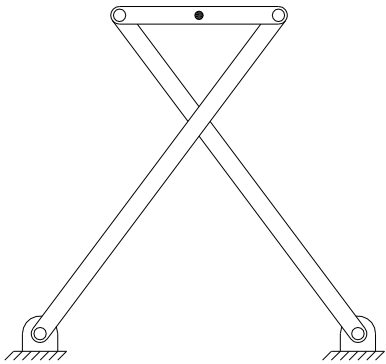
**Toggle Mechanism**



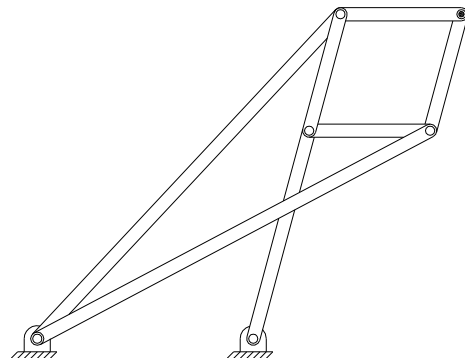
**Watt Straight-Line Mechanism  
(approximate)**



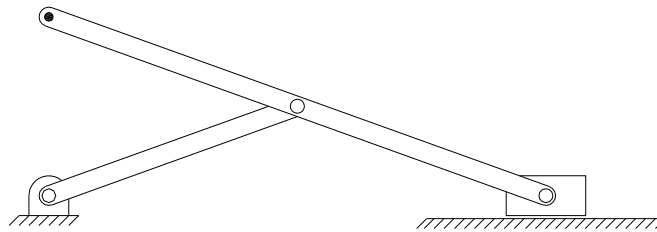
**Roberts Straight-Line Mechanism  
(approximate)**



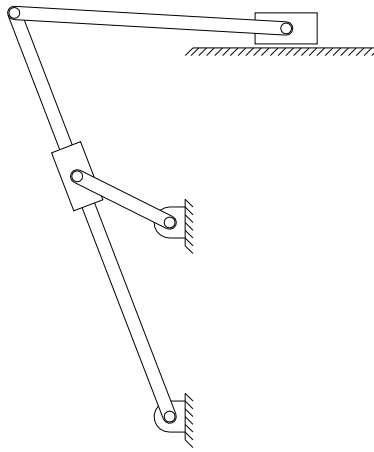
**Chebyshev Straight-Line Mechanism  
(approximate)**



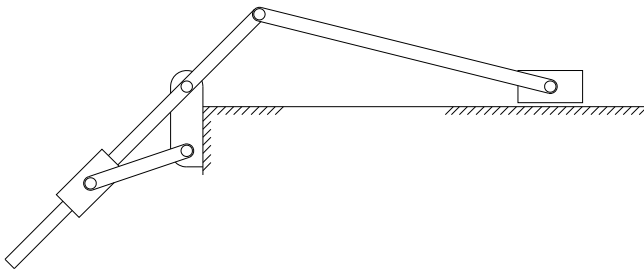
**Peaucellier Straight-Line Mechanism  
(exact)**



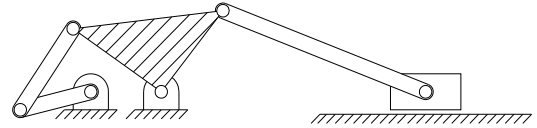
**Scott-Russell Straight-Line Mechanism  
(exact)**



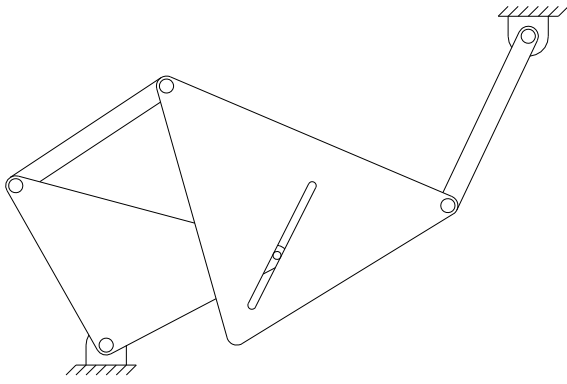
**Crank-Shaper Quick-Return Mechanism**



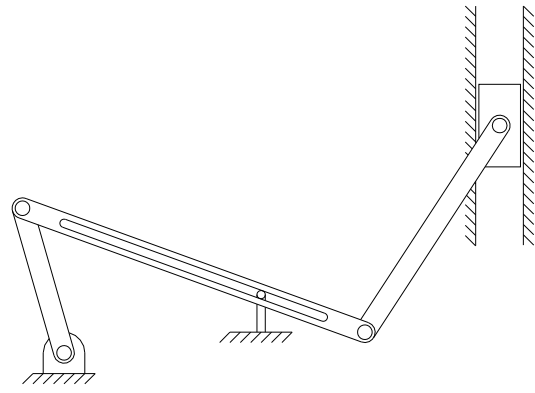
**Whitworth Quick-Return Mechanism**



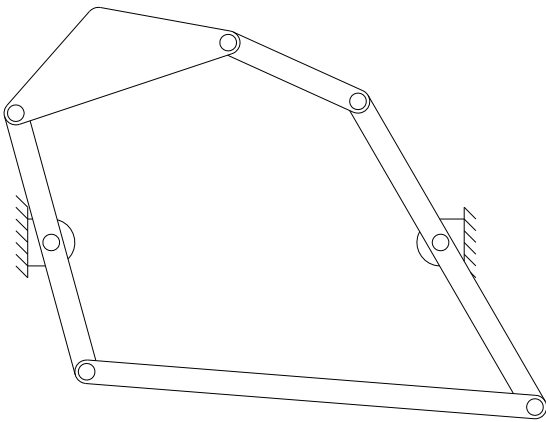
**Drag-Link Quick-Return Mechanism**



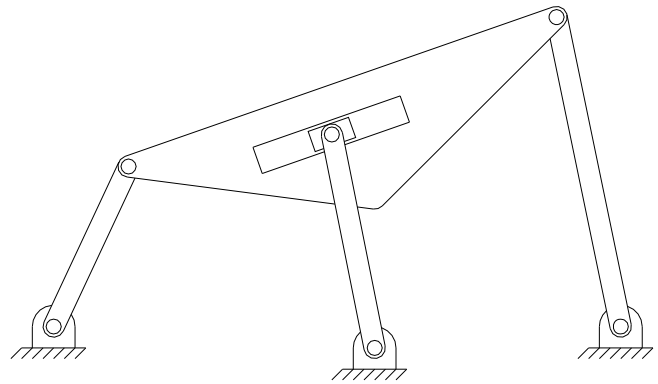
**5-bar Slotted Mechanism**



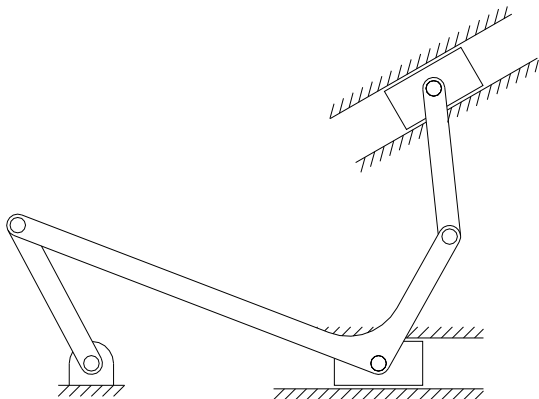
**5-bar Slotted Slider Mechanism**



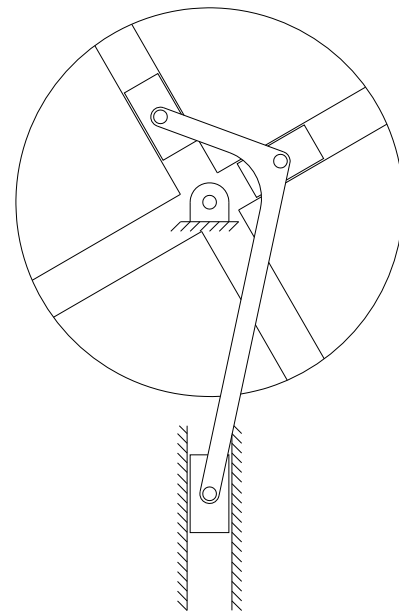
**6-bar Mechanism**



**6-bar Single-Slider Mechanism**

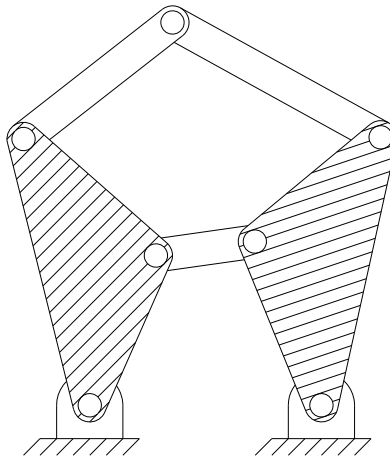


**6-bar Crank Dual-Slider Mechanism**

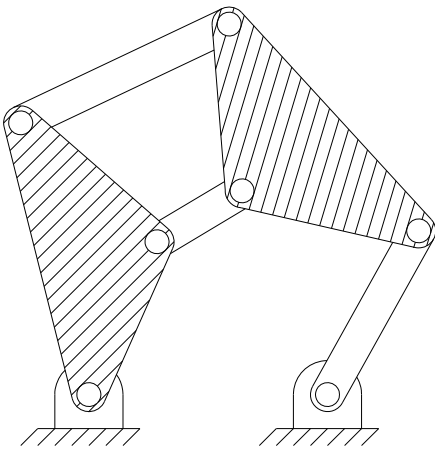


**6-bar Crank Triple-Slider Mechanism**

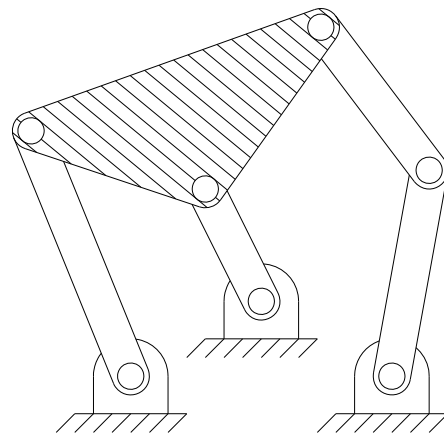




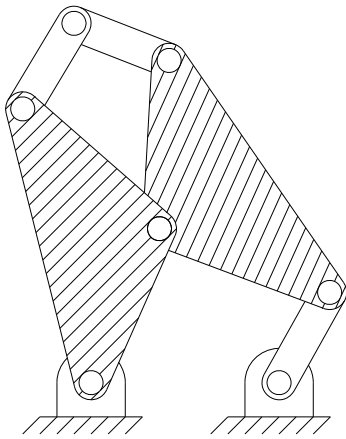
**Stephenson I 6-Bar Mechanism**



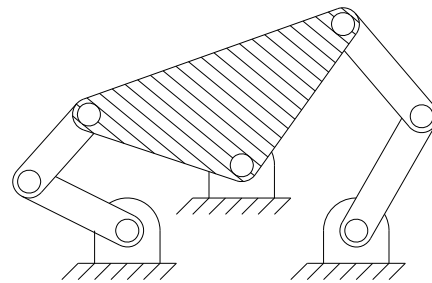
**Stephenson II 6-Bar Mechanism**



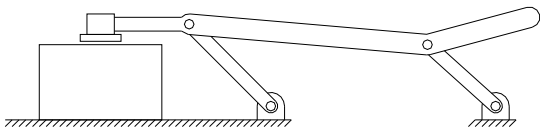
**Stephenson III 6-Bar Mechanism**



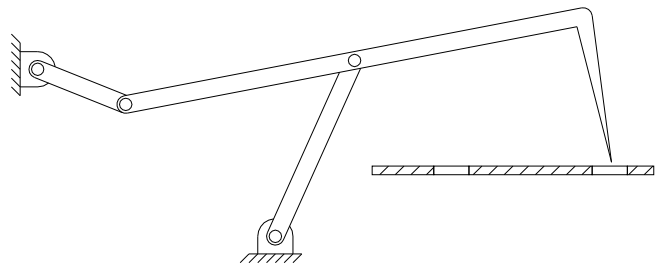
**Watt I 6-Bar Mechanism**



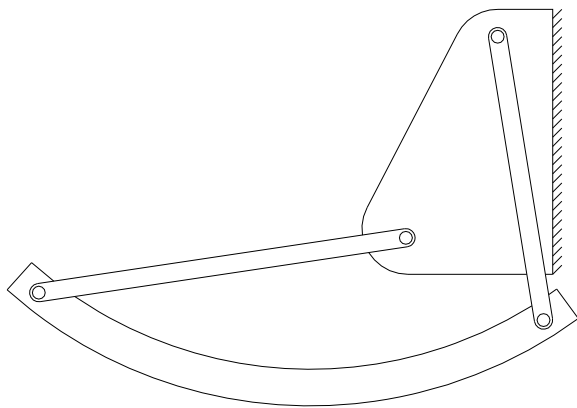
**Watt II 6-Bar Mechanism**



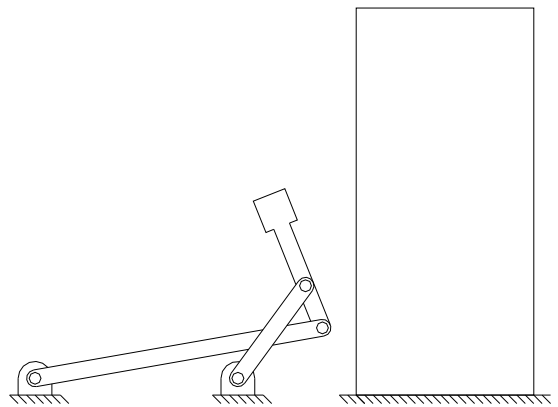
**4-Bar Clamp Mechanism**



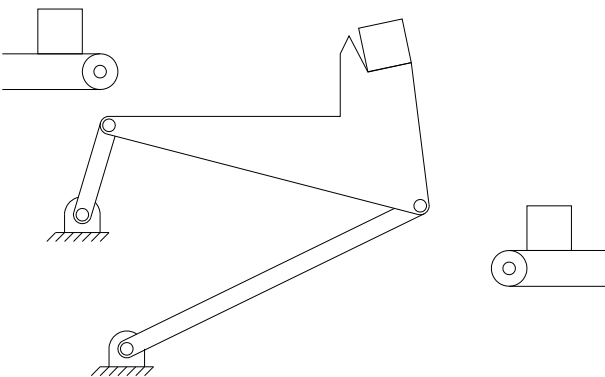
**4-Bar Film Advance Mechanism**



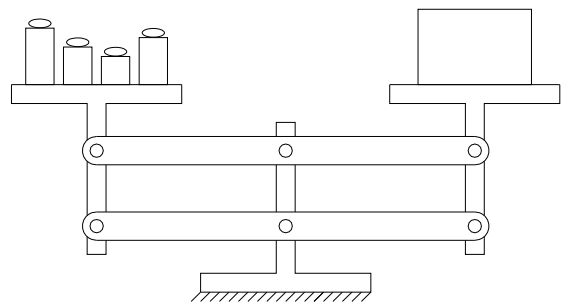
**4-Bar Aircraft Carry-on Bin Mechanism**



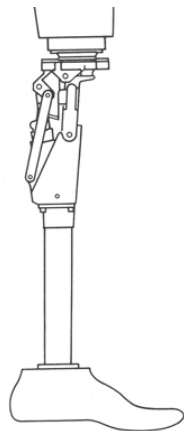
**4-Bar Bass Drum Pedal Mechanism**



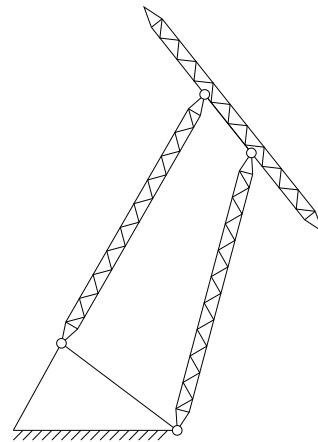
**4-Bar Conveyor Transfer Mechanism**



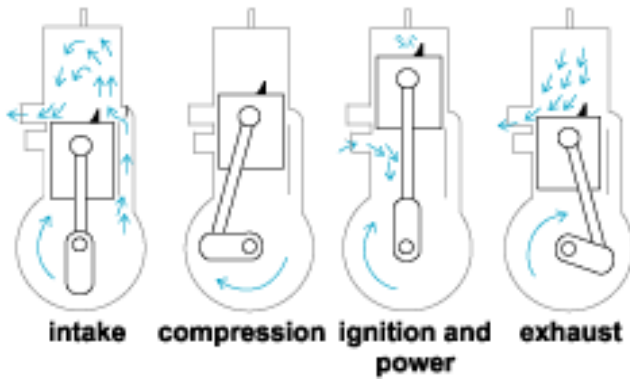
**Dual 4-bar Balance Scale Mechanism**



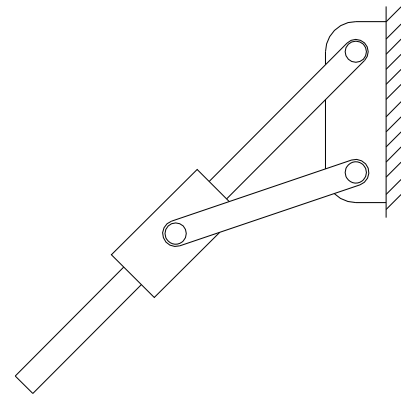
**4-Bar Knee Prosthesis Mechanism**



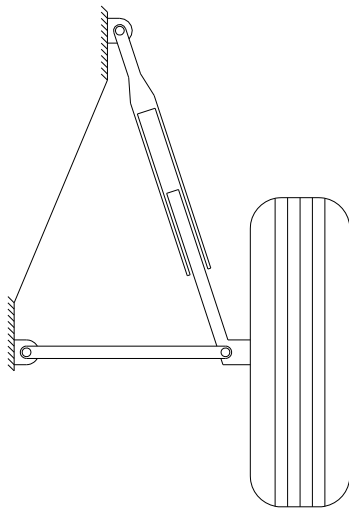
**4-Bar Crane Mechanism**



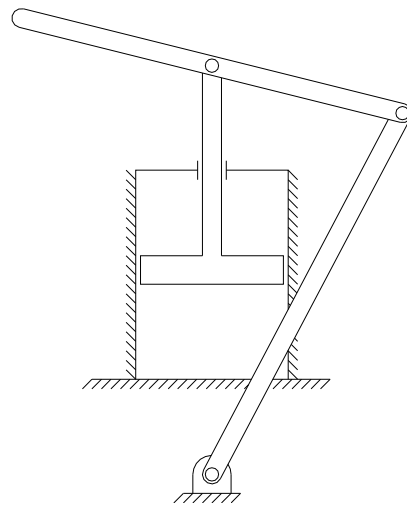
**2-Stroke Internal Combustion Engine Mechanism S-C Inversion 1**



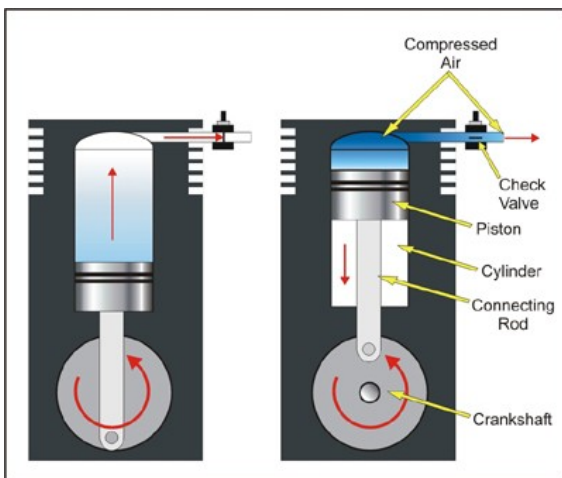
**Whitworth Mechanism S-C Inversion 2**



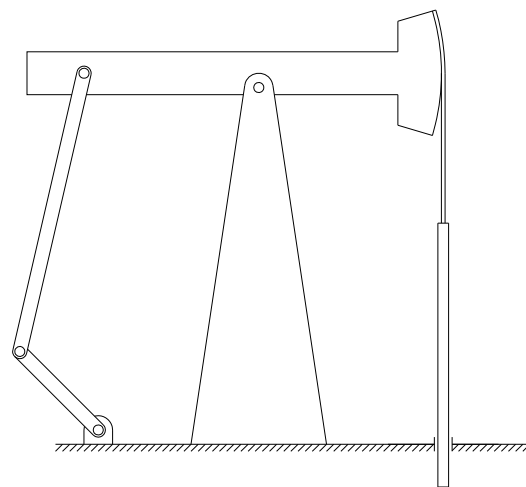
**MacPherson Strut Mechanism S-C Inversion 3**



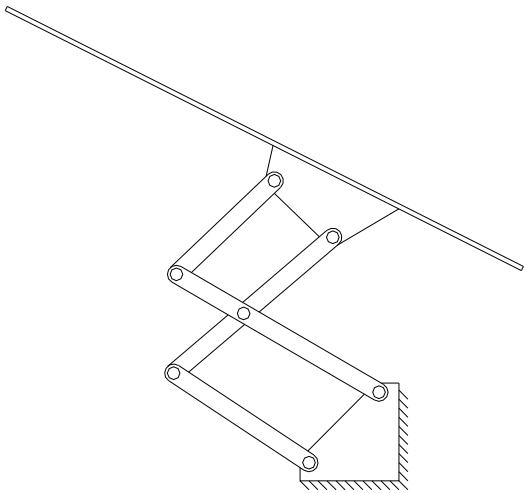
**Pump Mechanism S-C Inversion 4**



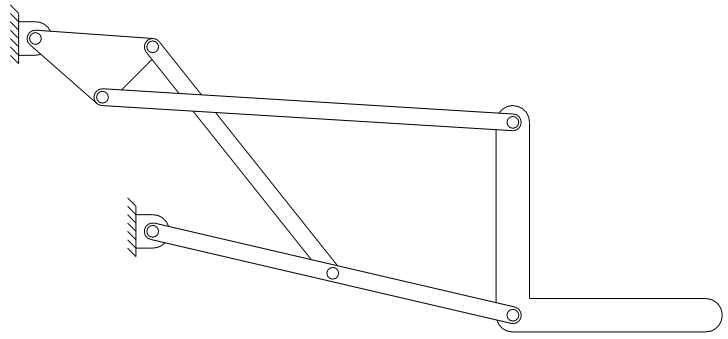
**Air Compressor Mechanism S-C Inversion 1**



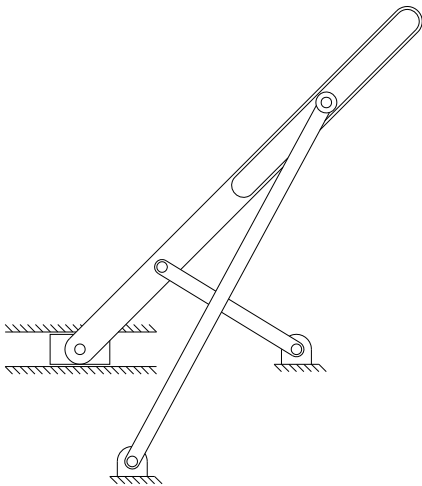
**5-bar Oil Well Pump Mechanism**



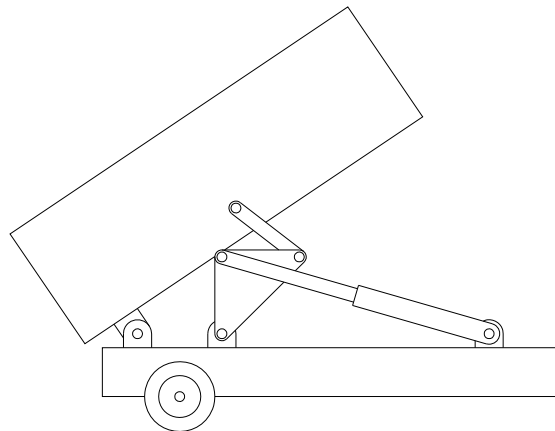
**6-bar Car Hood Mechanism**



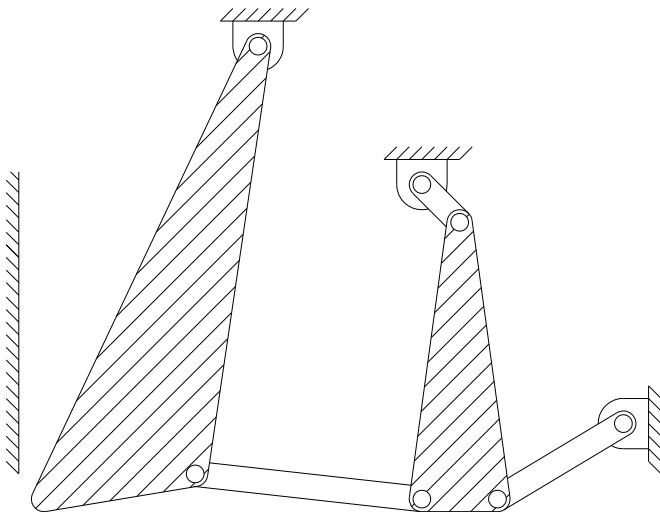
**6-bar Lift Mechanism**



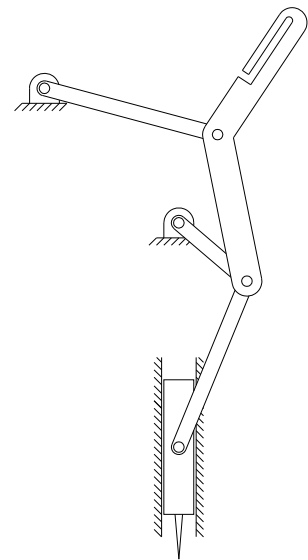
**6-bar Window Mechanism**



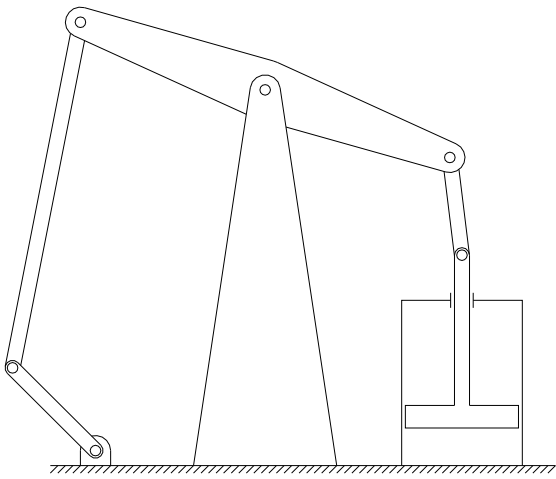
**6-bar Dump Truck Mechanism**



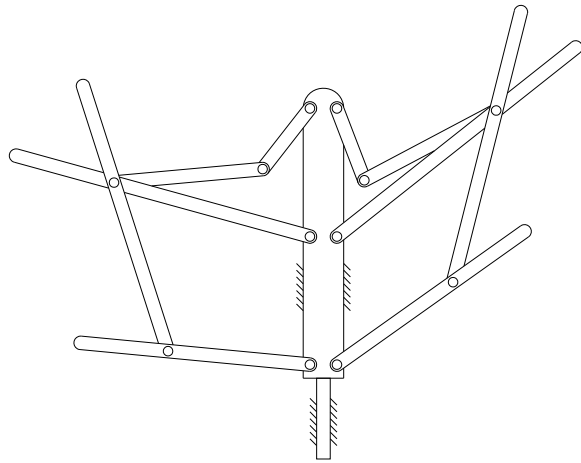
**6-bar Rock Crusher Mechanism**



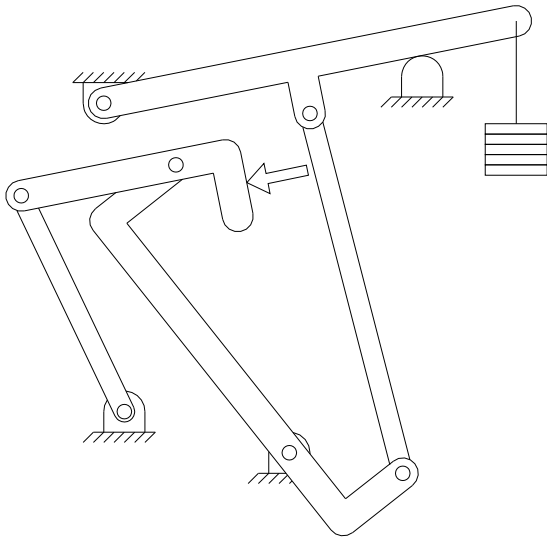
**6-bar Sewing Machine Mechanism**



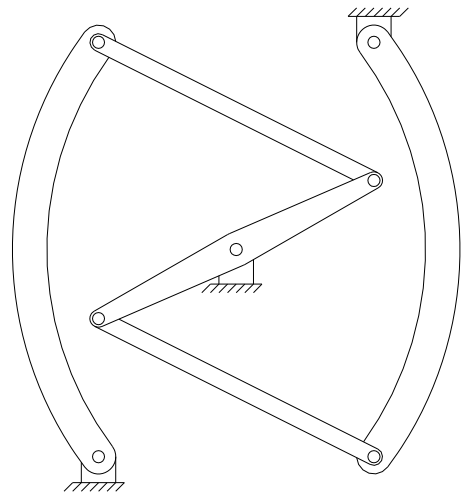
**6-bar Watt Steam Engine Mechanism**



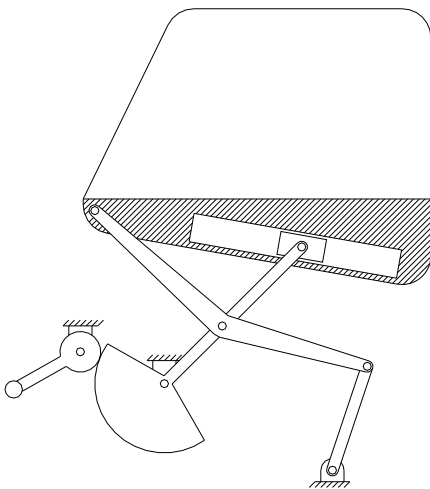
**Dual 6-bar Mechanism Collapsible Music Stand**



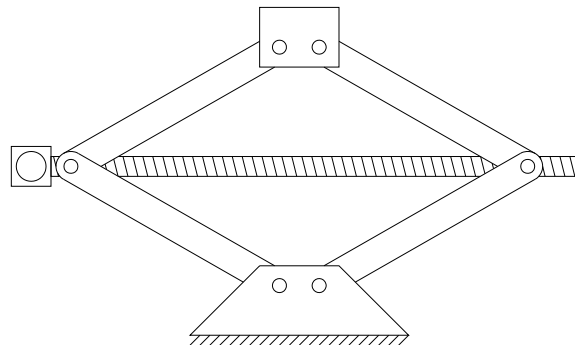
**6-bar Leg Press Mechanism**



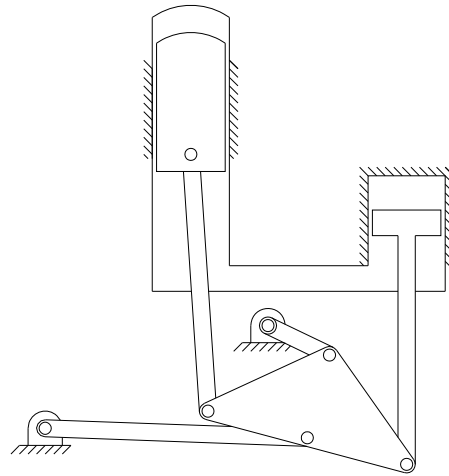
**6-bar Drum Brake Mechanism**



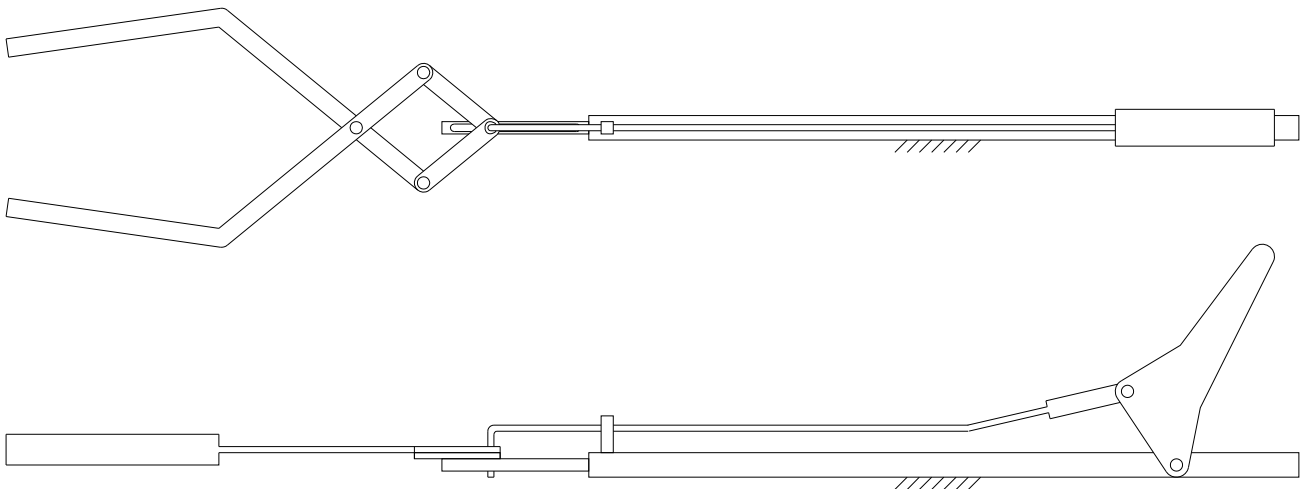
**7-bar Car Window Mechanism**



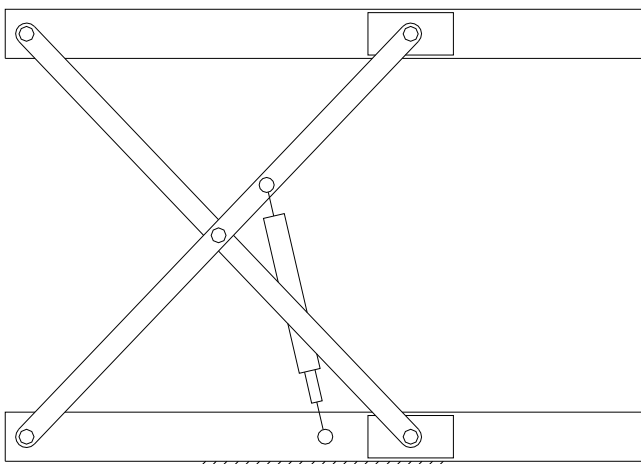
**7-bar Car Jack Mechanism**



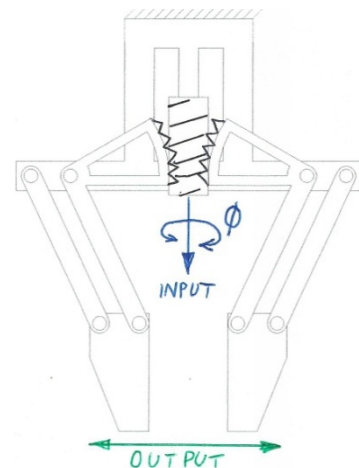
**7-bar Ross Stirling Engine Mechanism**



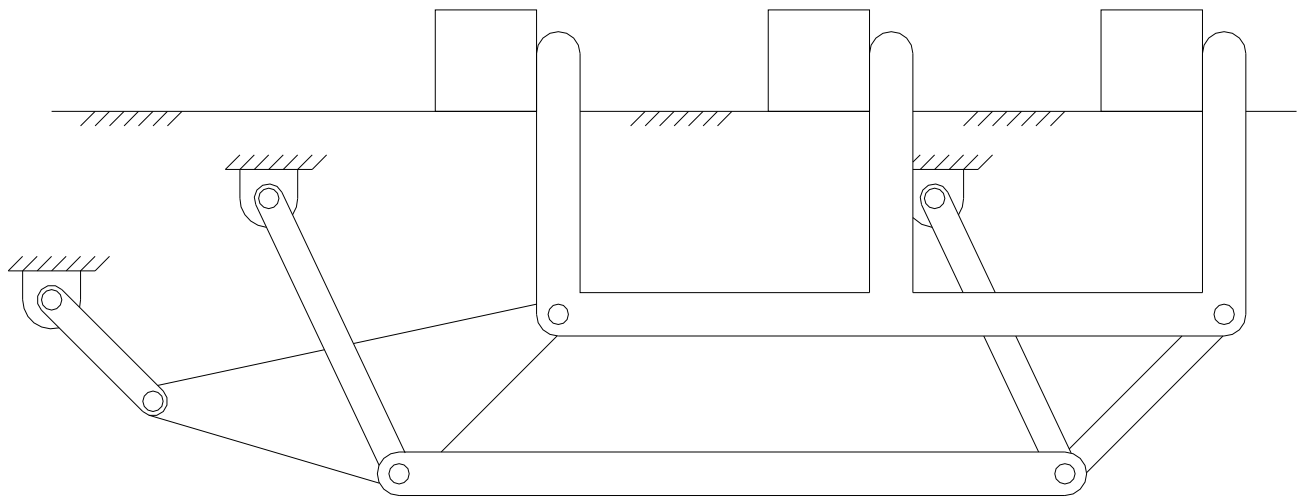
**7-bar Grabber/Extender Compound Mechanism**



**8-bar Scissor-Lift Mechanism**

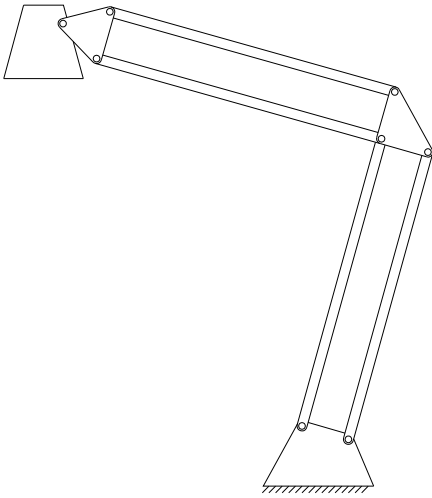


**8-bar Robot Gripper Mechanism**

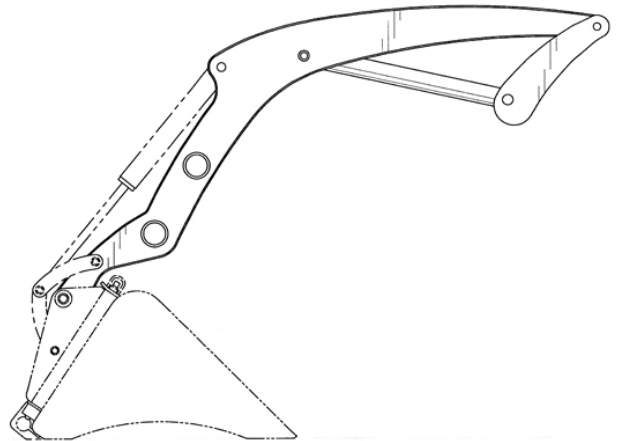


**8-Bar Straight-Line Transfer Mechanism**

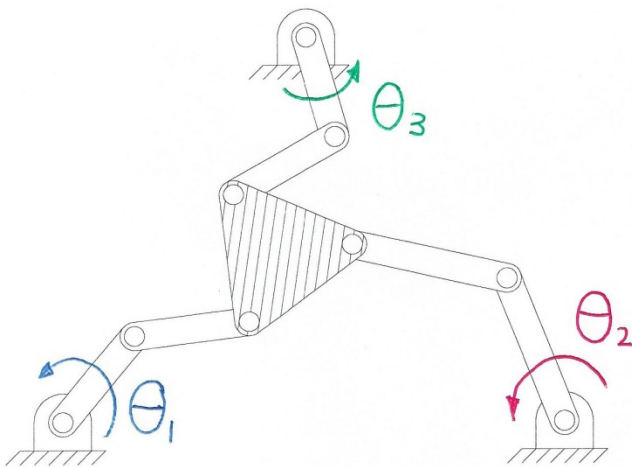
## Multi-dof Robots



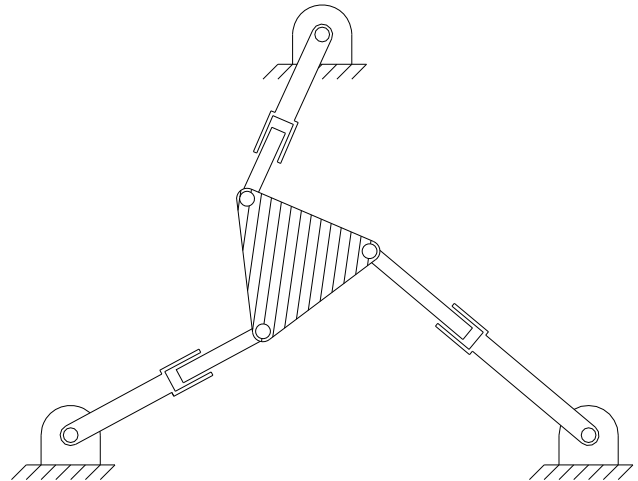
**3-dof 8-bar Desk Lamp Robot**



**2-dof 9-bar Front-End Loader Robot**

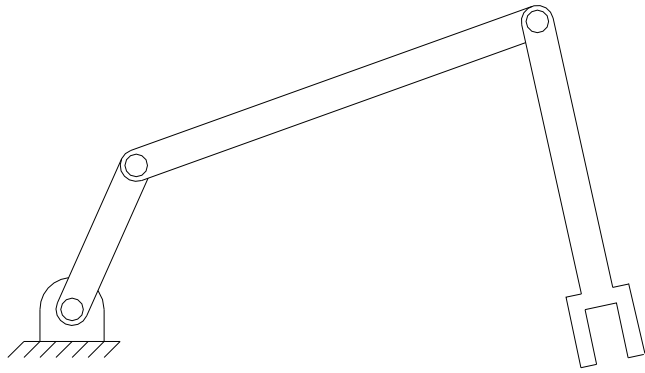


**3-dof 3-RRR Parallel Robot**



**3-dof 3-RPR Parallel Robot**

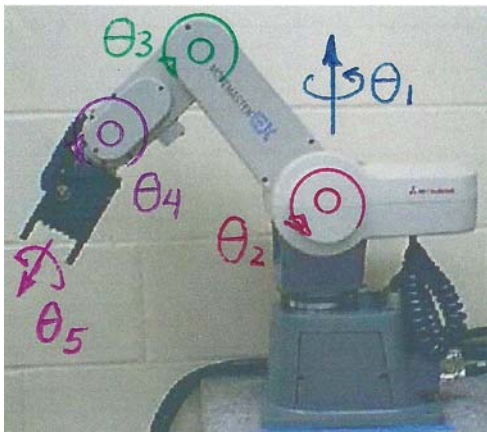




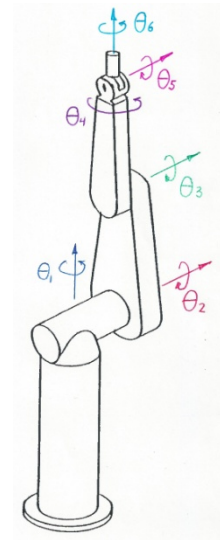
**Planar 3-dof Robot**



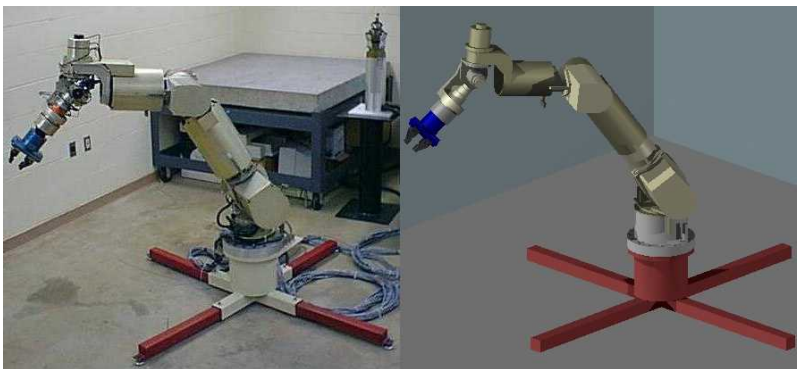
**Adept 4-dof SCARA Robot**



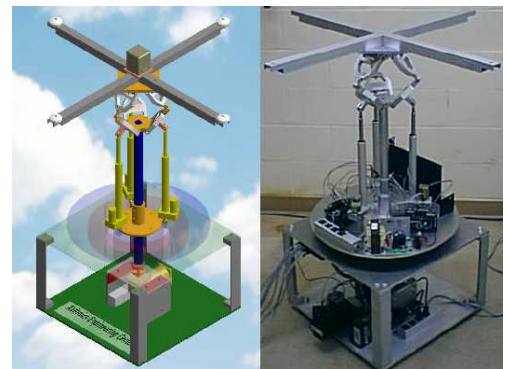
**Mitsubishi 5-dof Robot**



**PUMA 6-dof Robot**

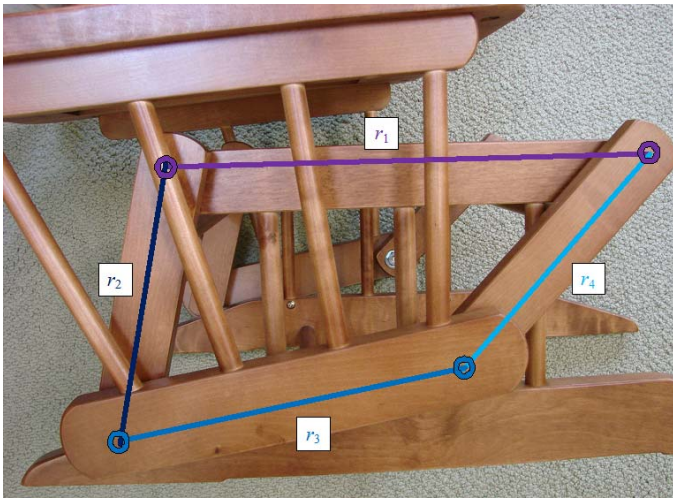


**NASA 8-dof ARMII Robot**



**3-dof Carpal Wrist Robot**

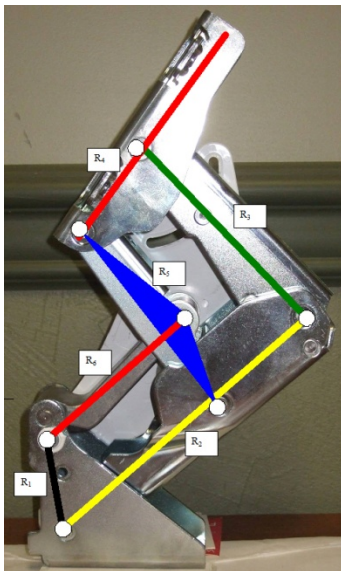
# Real-World Mechanisms / Kinematic Diagrams



4-bar Glider-Rocker Mechanism



Bicycle/Human Leg 4-bar Mechanism (lock ankle)



Hettich Hinge Watt I 6-bar Mechanism

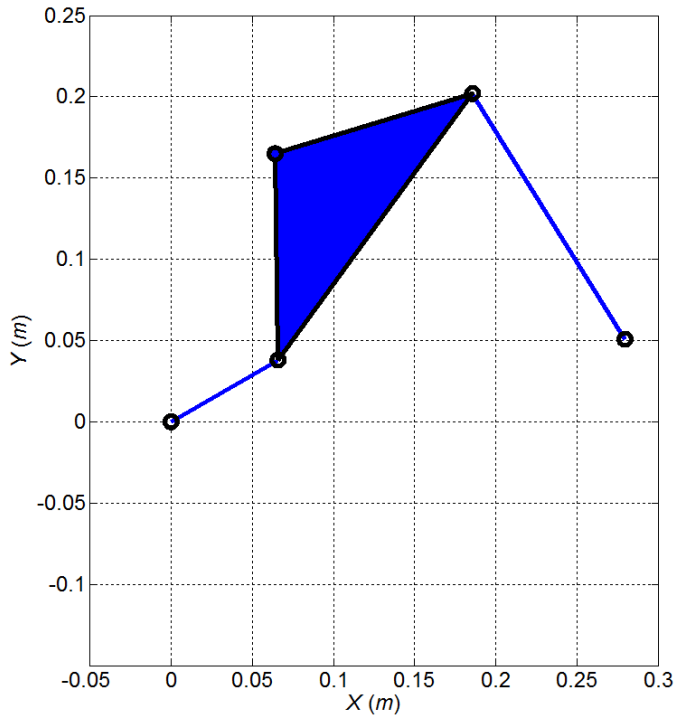


Mountain Bike Rear Suspension Mechanism

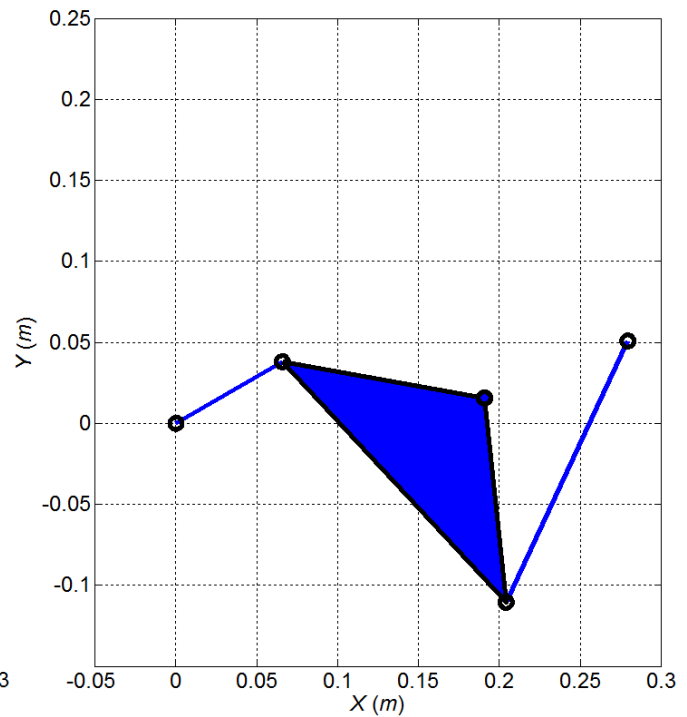
## MATLAB Simulation/Animation Gallery

All of the following MATLAB graphics/animations were created by Dr. Bob at Ohio University. These are presented according to the Ohio University course they support.

### ME 3011 Kinematics & Dynamics of Machines and Introduction to Vibrations

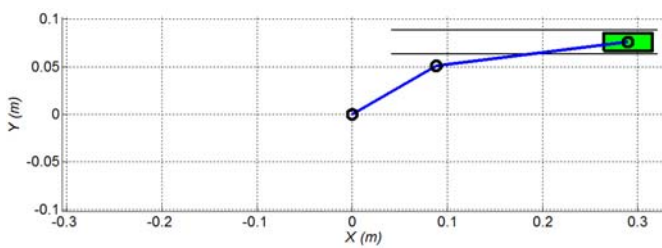


Open Branch

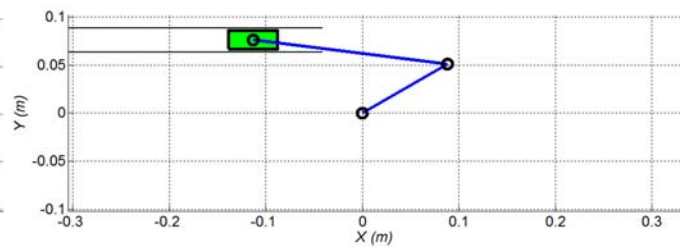


Crossed Branch

Four-Bar Mechanism

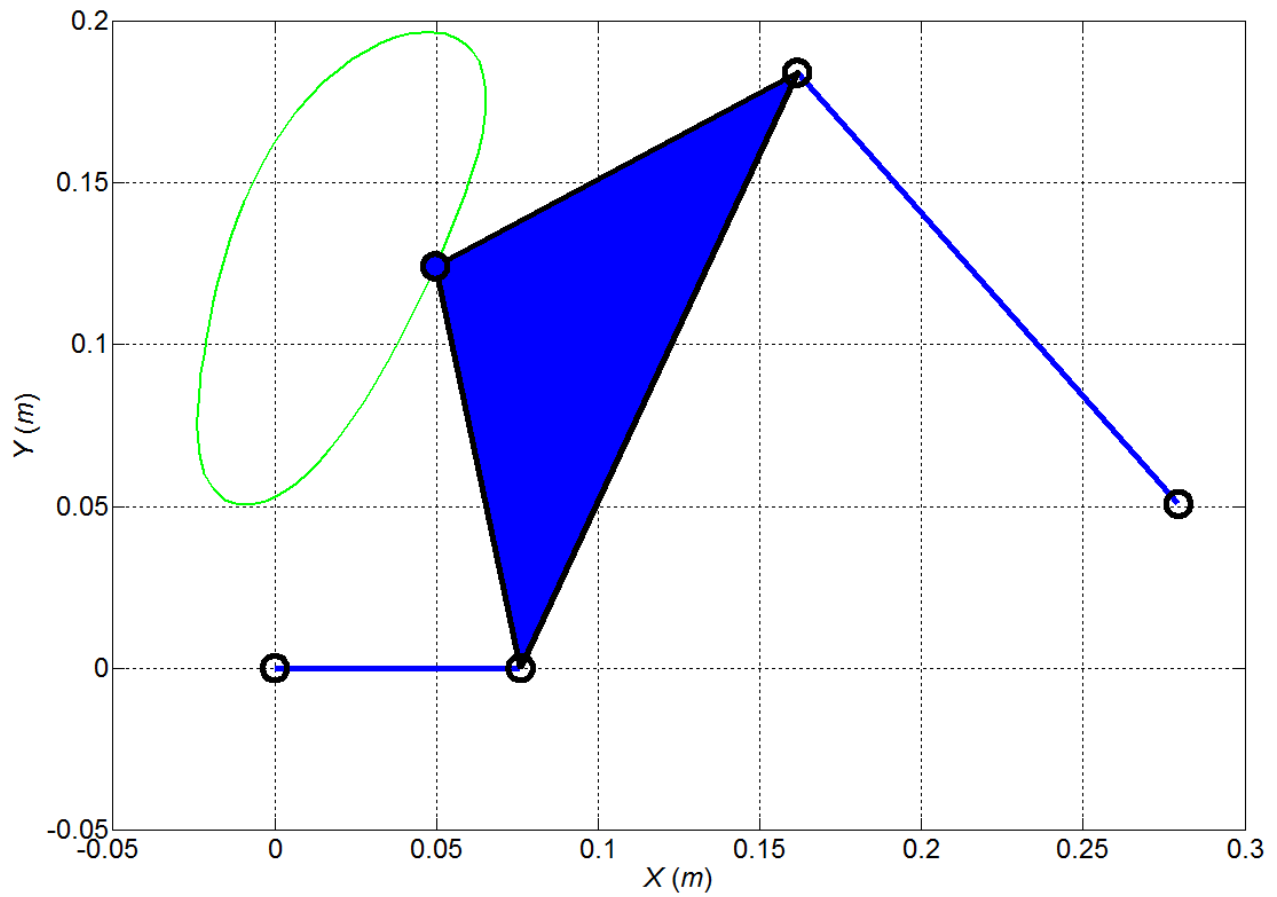


Right Branch

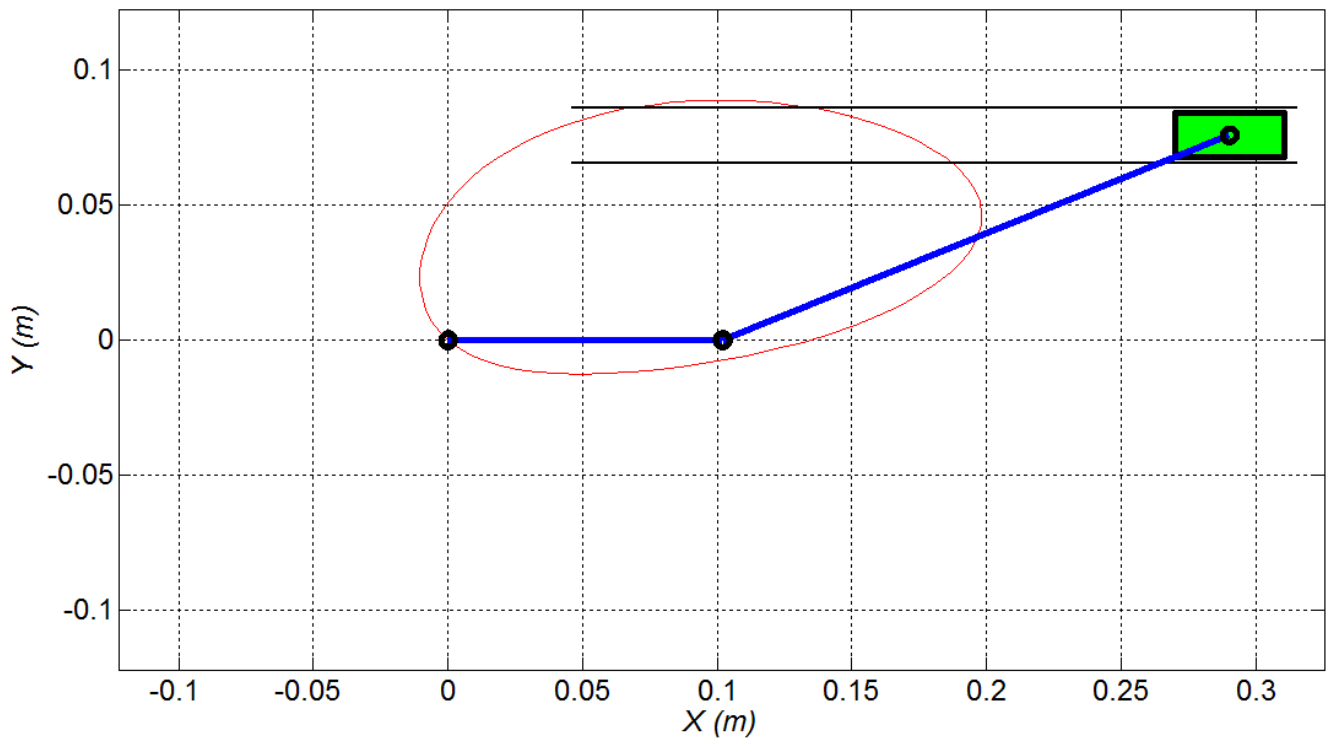


Left Branch

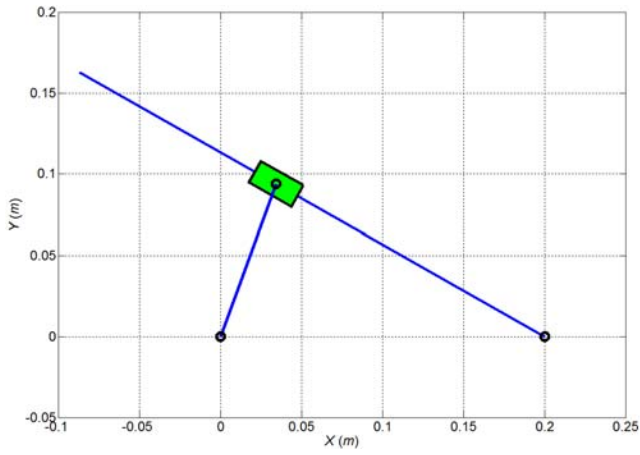
Slider-Crank Mechanism



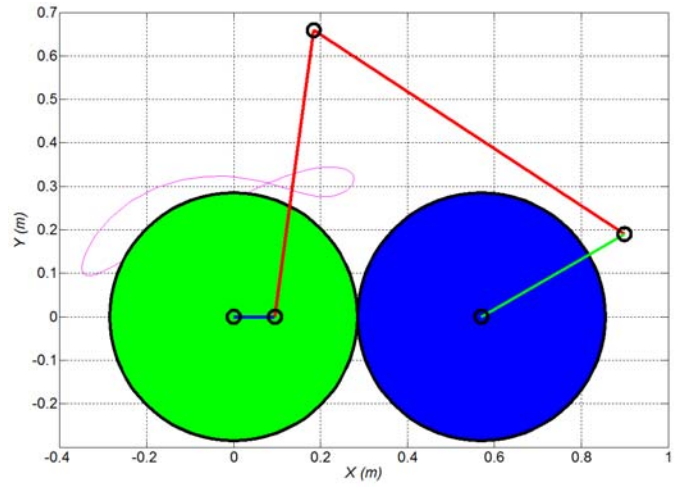
**Four-Bar Mechanism Coupler Curve**



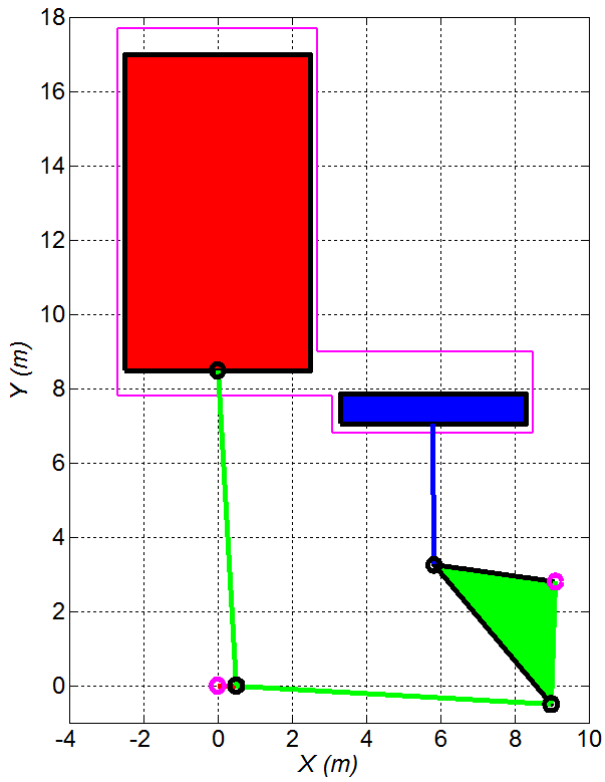
**Slider-Crank Mechanism Coupler Curve**



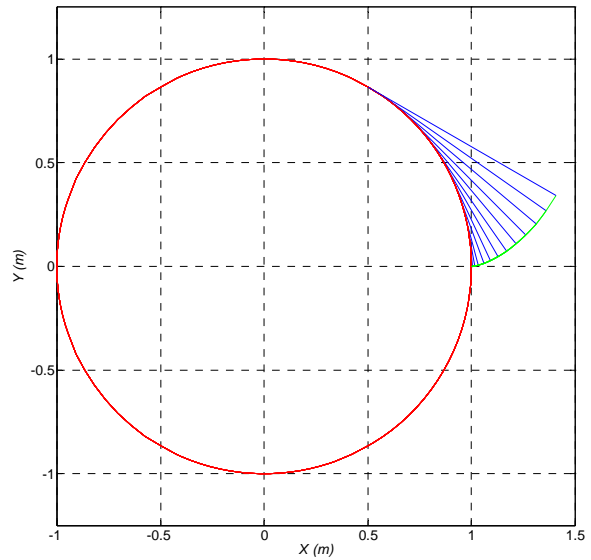
**Slider-Crank Mechanism, Inversion 2**



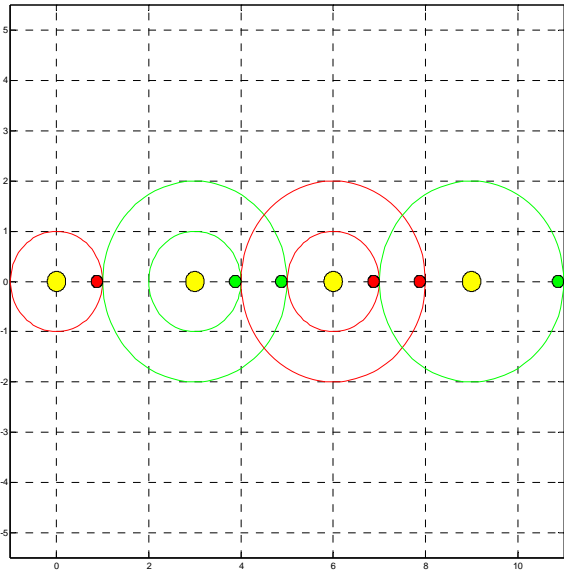
**Geared Five-Bar Mechanism**



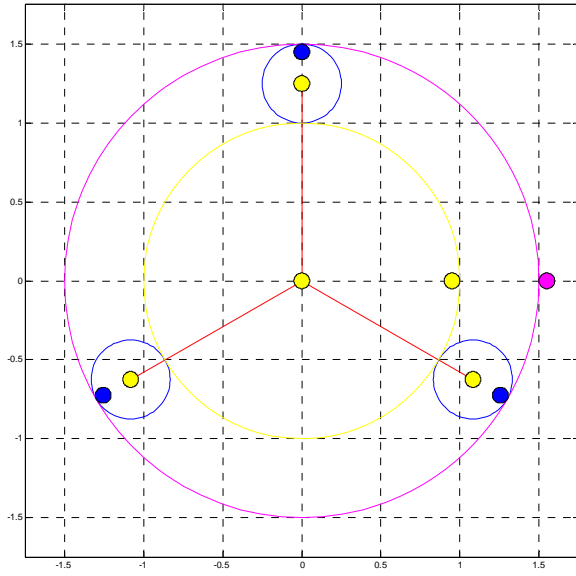
**Ross-Yoke Stirling Engine Mechanism**



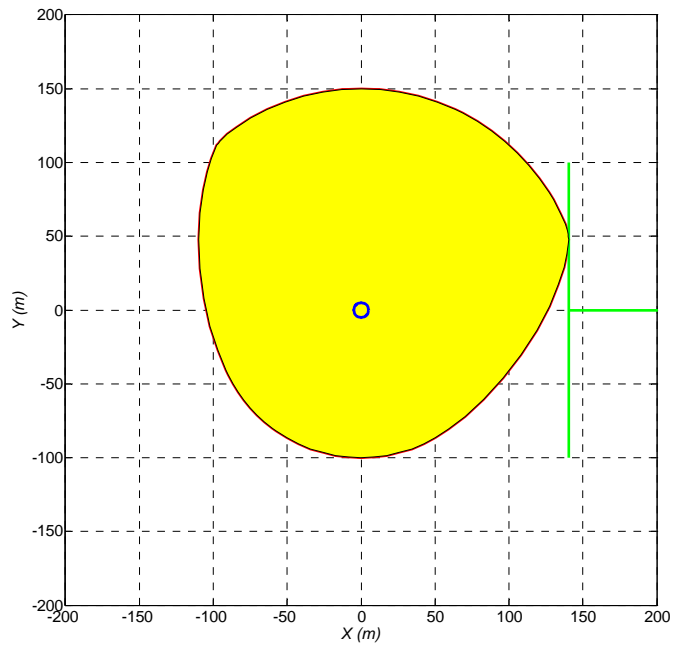
**Involute Gear Tooth Construction**



**Gearbox Simulation**

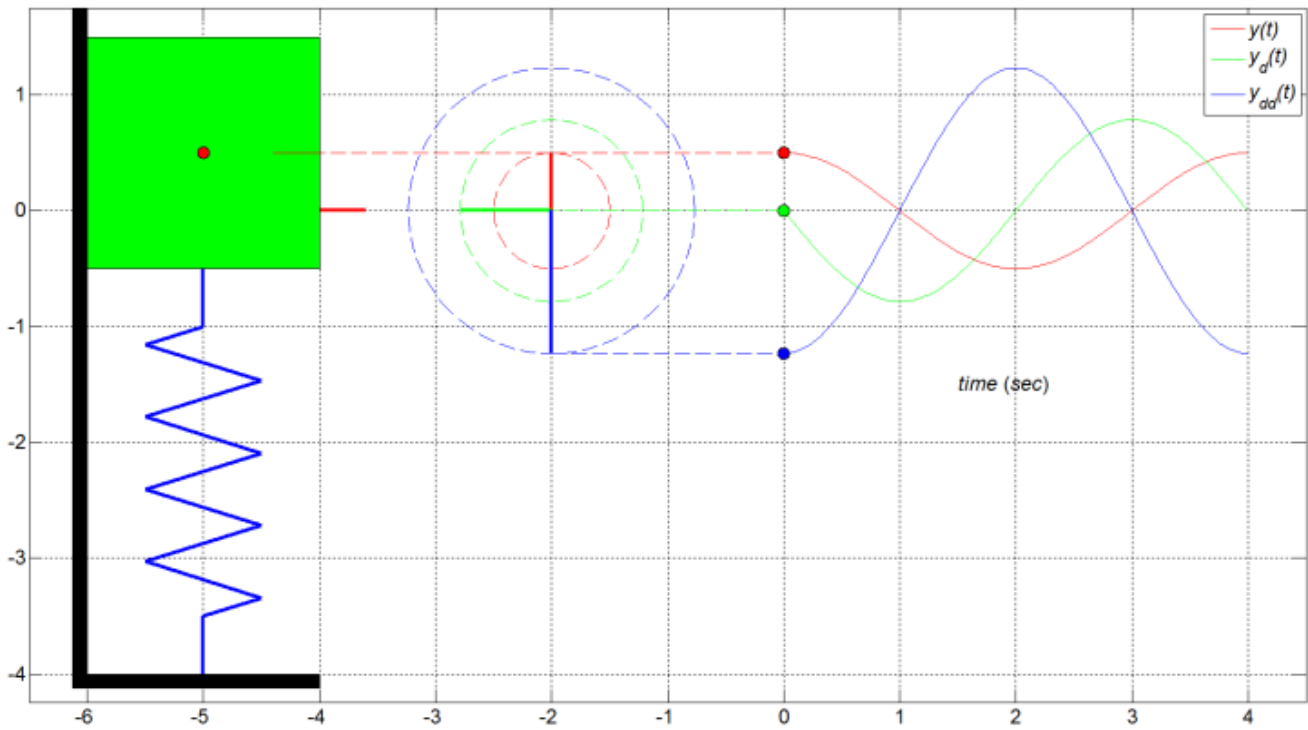


**Planetary Gear Train Simulation**

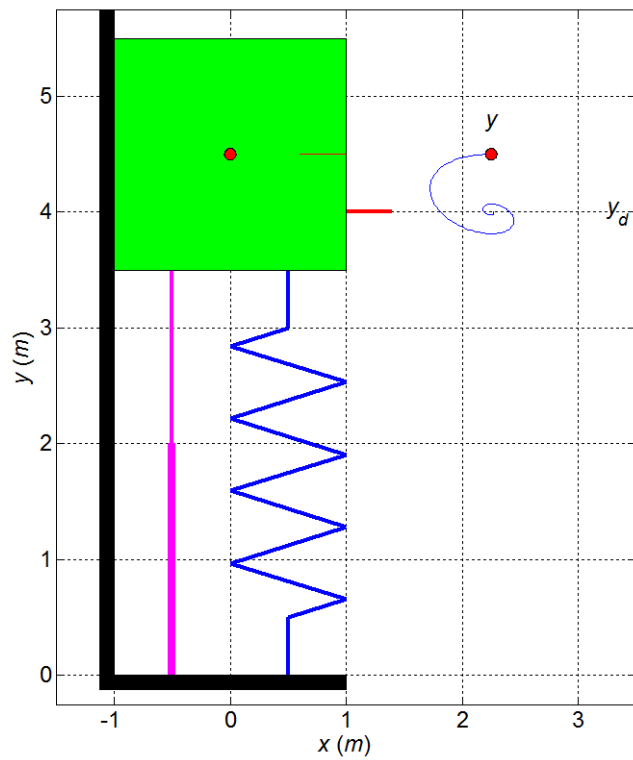


**Cam/Follower Animation**

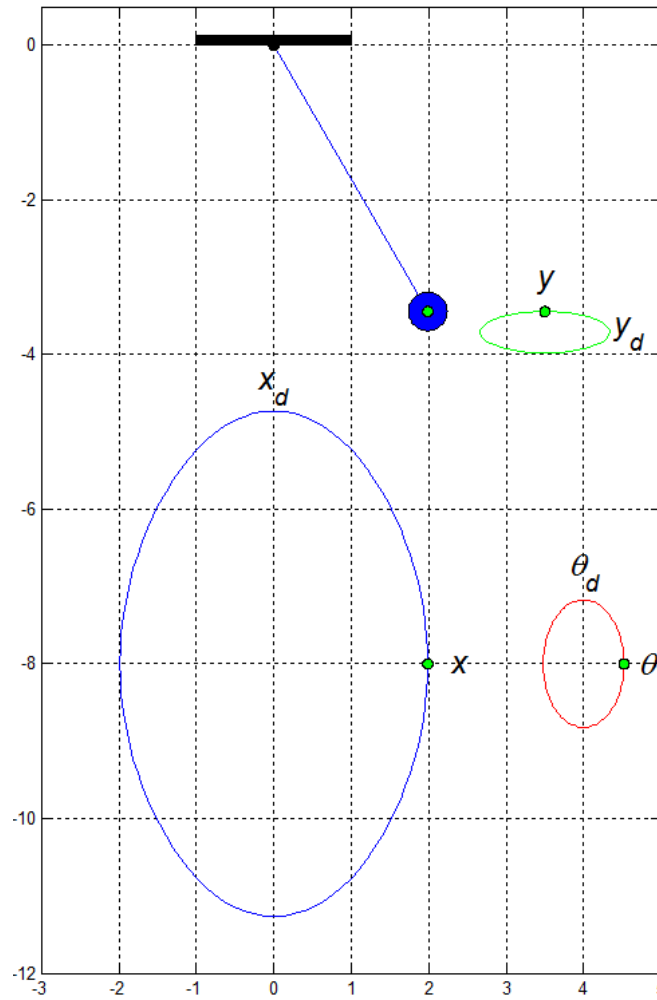
Mechanical Vibrations



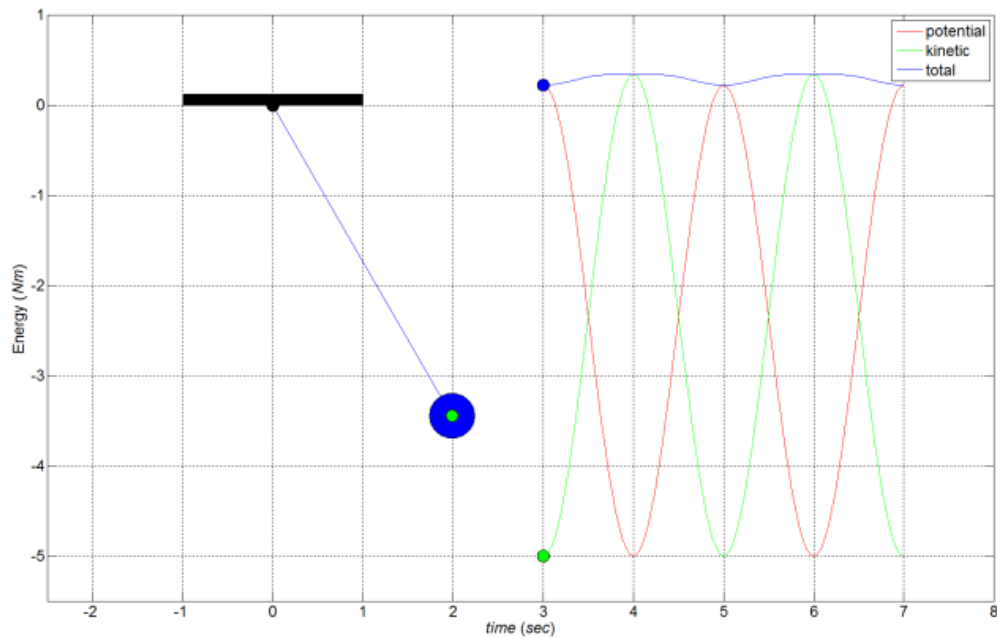
1-dof m-k Vibrational System, Undamped Simple Harmonic Motion, Rotating Phasors



1-dof m-k Vibrational System, Underdamped Response with Phase Plot



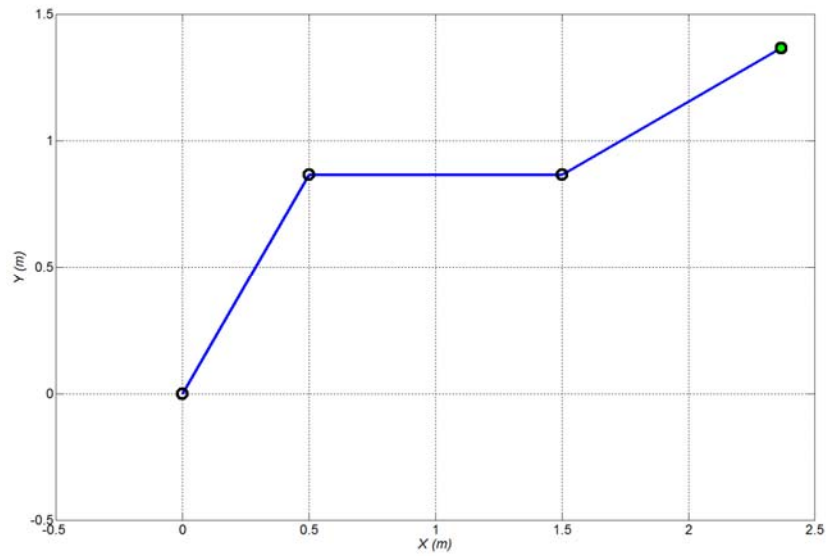
1-dof Pendulum Vibrational System, Simple Harmonic Motion with Phase Plots



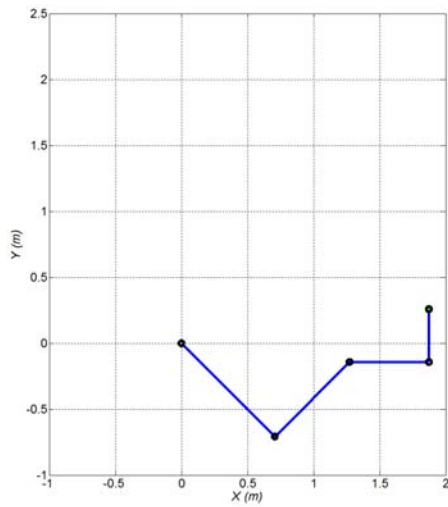
1-dof Pendulum Vibrational System, Simple Harmonic Motion with Energy Plot



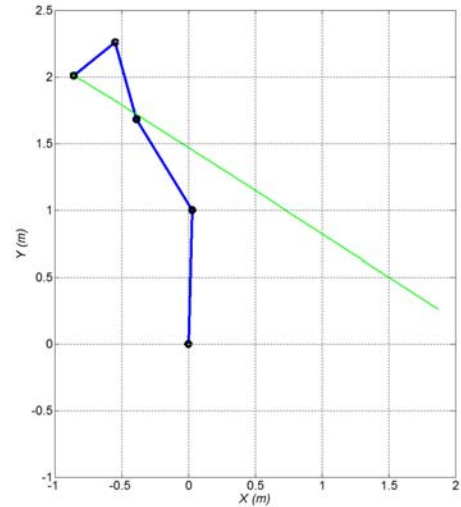
## ME 4290/5290 Mechanics of Robotic Manipulators



**Planar 3R robot snapshot**

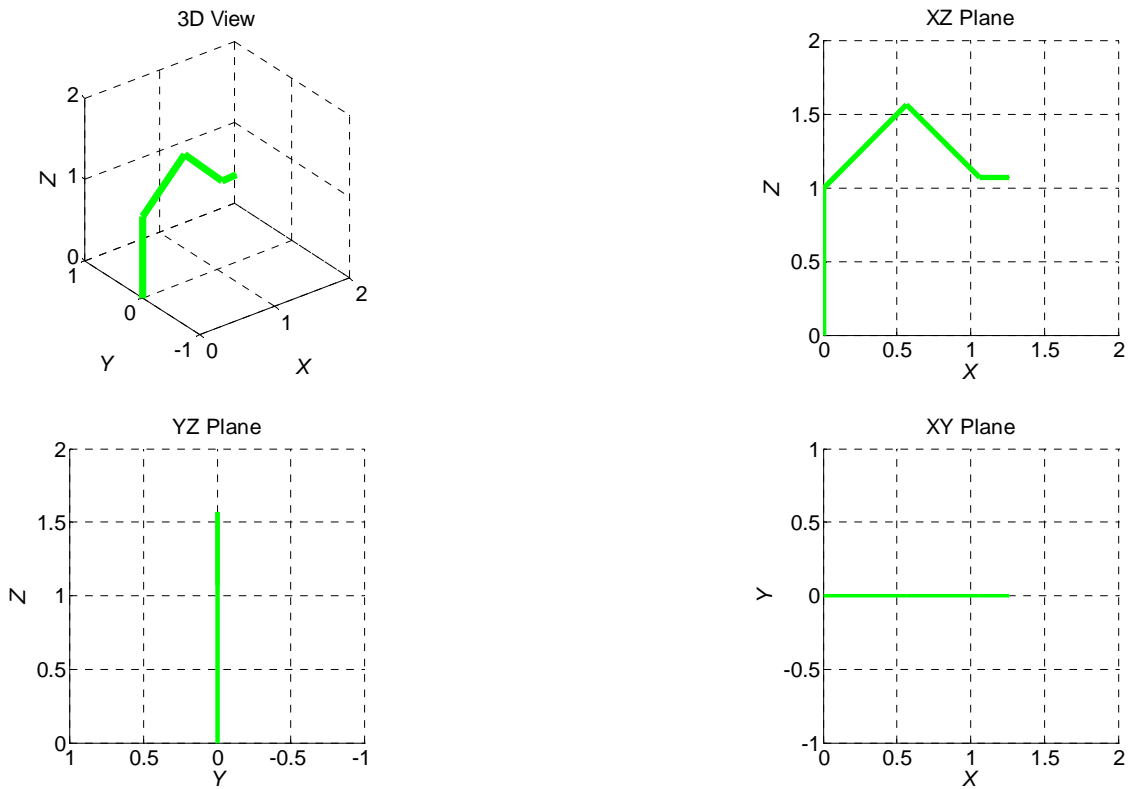


**Initial Robot Pose**

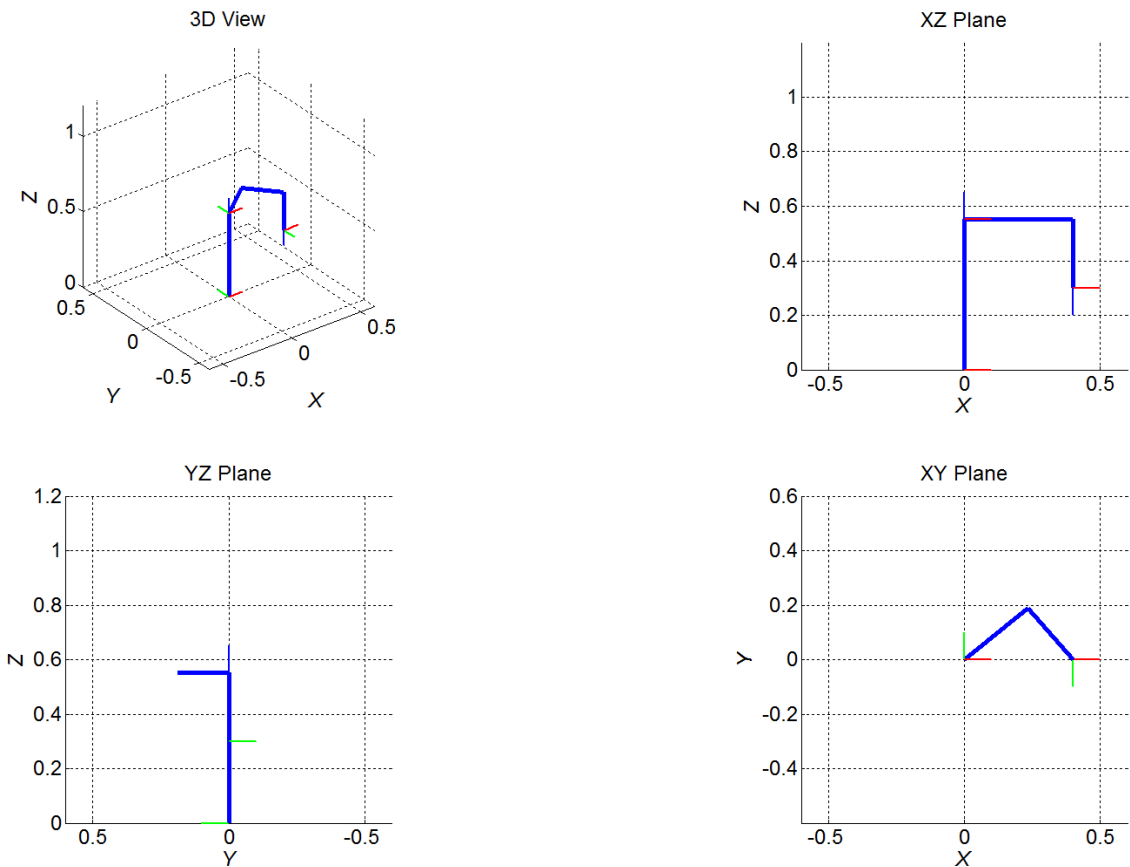


**Final Robot Pose**

## Planar 4R Kinematically-Redundant Robot Resolved-Rate Control Simulation

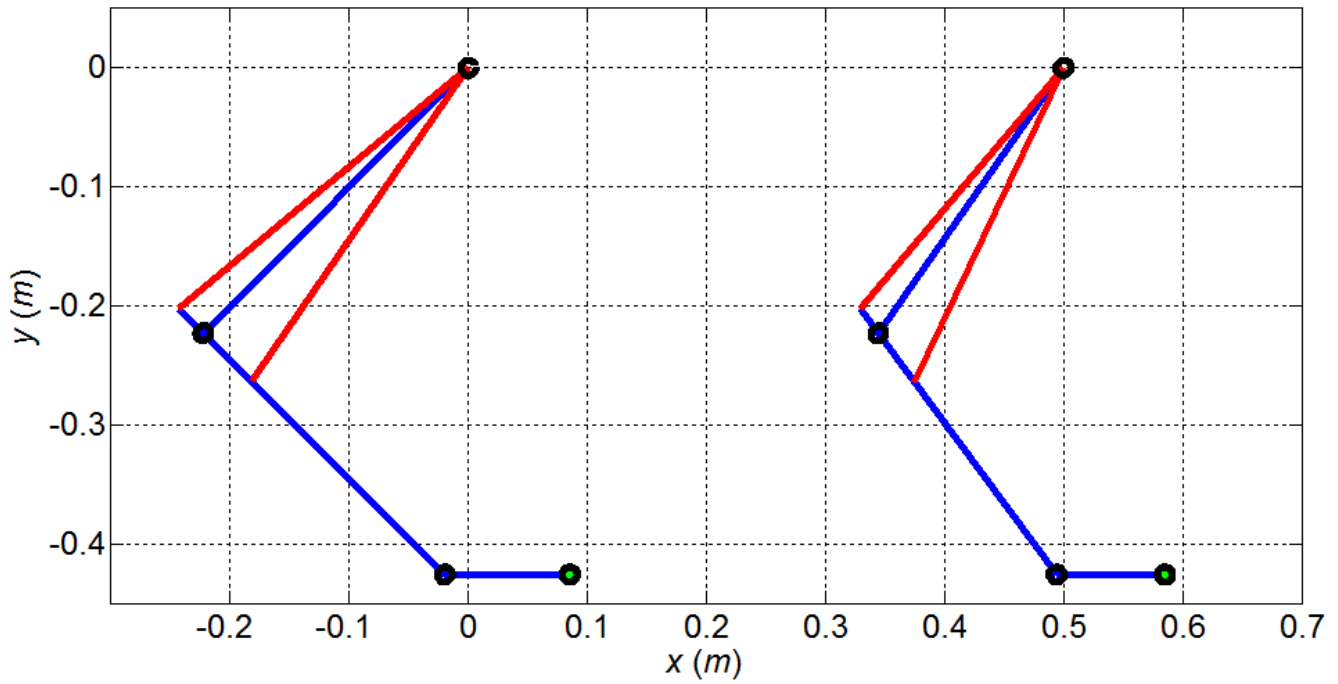


**Spatial 4R Kinematically-Redundant Robot Resolved-Rate Control Simulation**

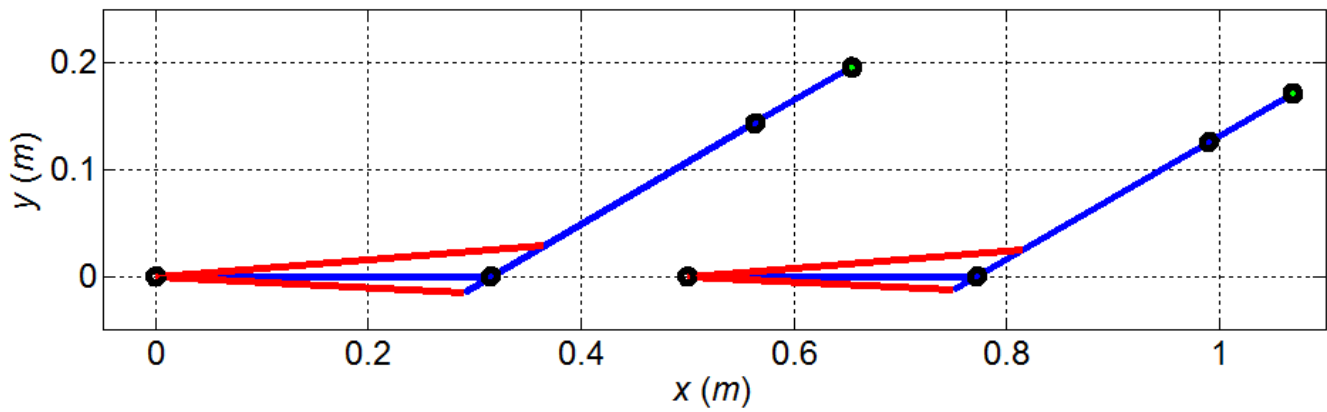


**Adept 550 4-dof SCARA Robot MATLAB Simulation/Animation**

## ME 4670 / BME 5670 Biomechanics of Human Motion



Inverse Pose Kinematics Snapshot  
(male left, female right)



Human Elbow/Biceps/Triceps Dynamic Simulation (male left, female right)