

Four Bar Linkages

1. Types of linkages
2. Synthesis (Design)

Four Bar Linkage

- ❑ *Simplest 1 dof linkage*
- ❑ *Used very commonly*

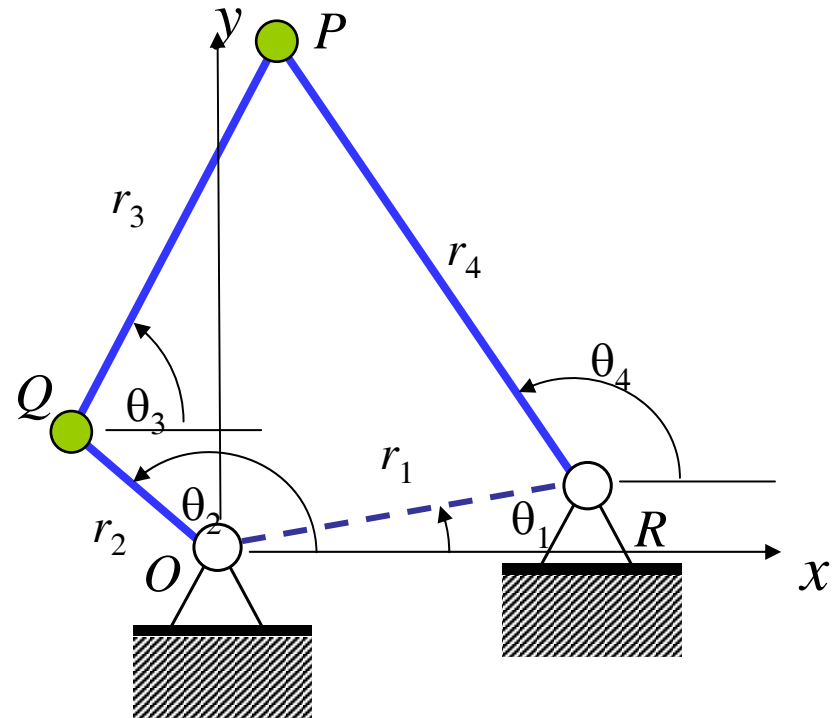
Types of four bar linkages

Grashof Type I

- Crank rocker $s + l < p + q$
- Double-rocker
- Drag-link

Non-Grashof or Grashof Type II

- Triple-rocker $s + l > p + q$



s = smallest link length
 l = longest link length
 p, q = other two lengths

Facts

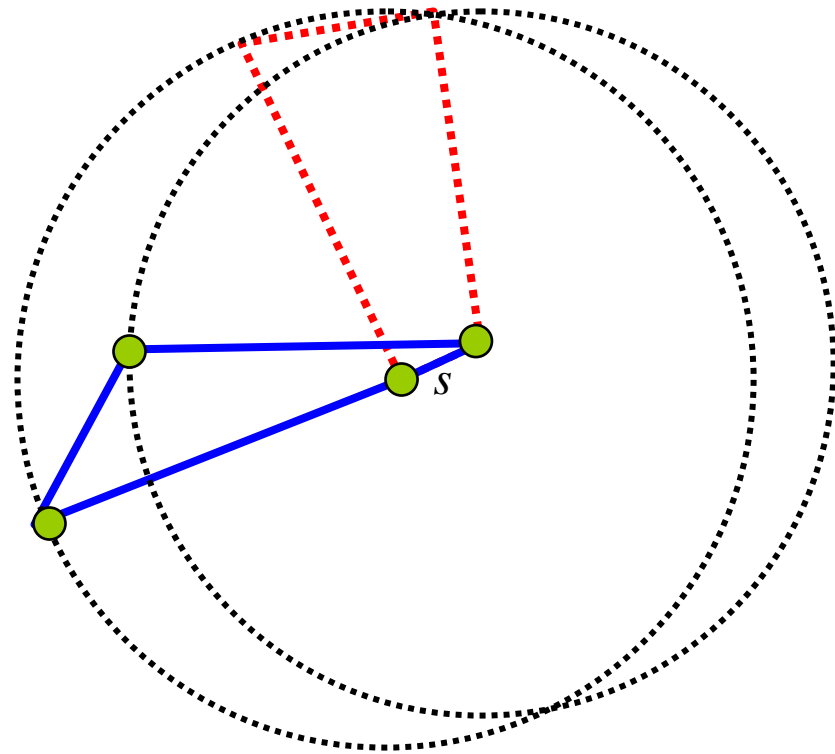
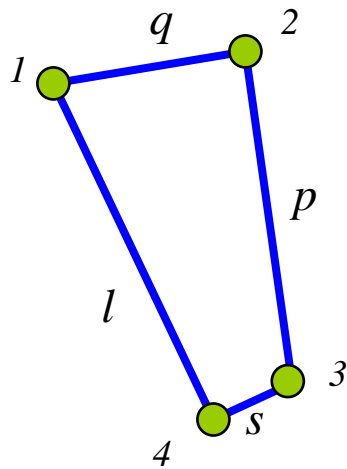
□ Grashof linkages

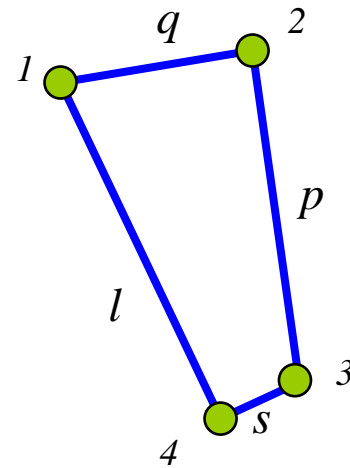
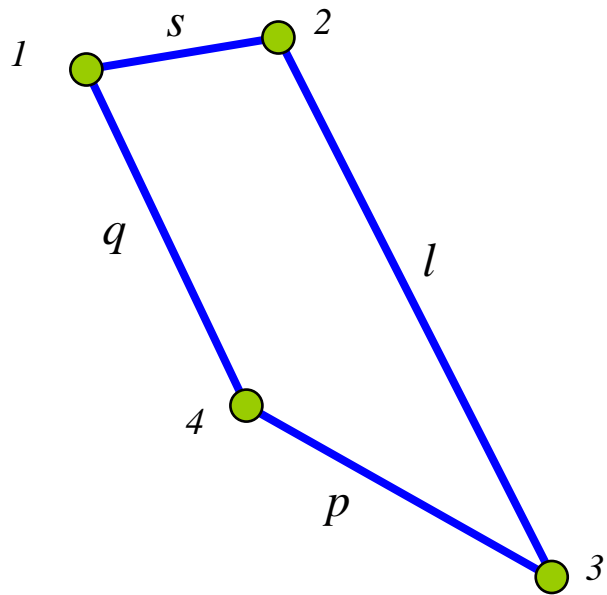
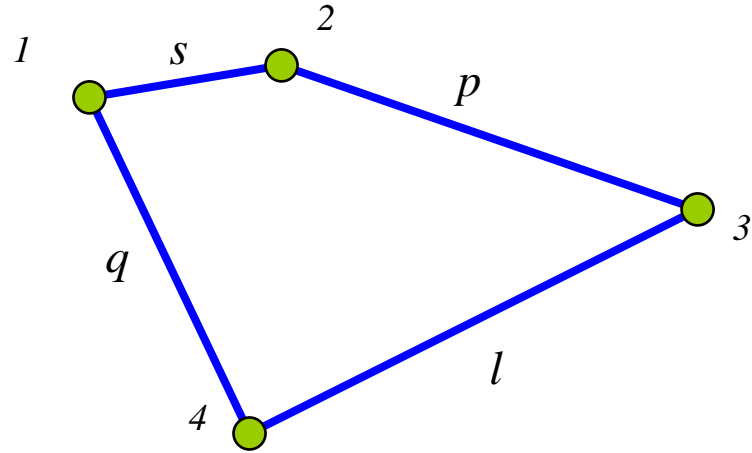
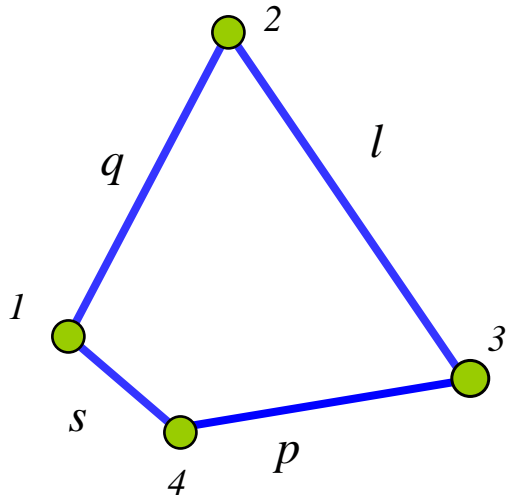
- There exists one link that completes a full 360 degree rotation relative to another link
- This is the shortest link
- The pair of joints connecting this link to other links are such that they rotate through 360 degrees
- Three types of linkages
 - Crank rotates through 360 deg. (relative to frame)
 - Coupler rotates through 360 deg. (relative to frame)
 - Frame rotates through 360 deg. (relative to, let us say, crank)

□ Non Grashof linkages

- No link completes a full 360 degree rotation relative to another link

Geometric significance of Grashof Inequality

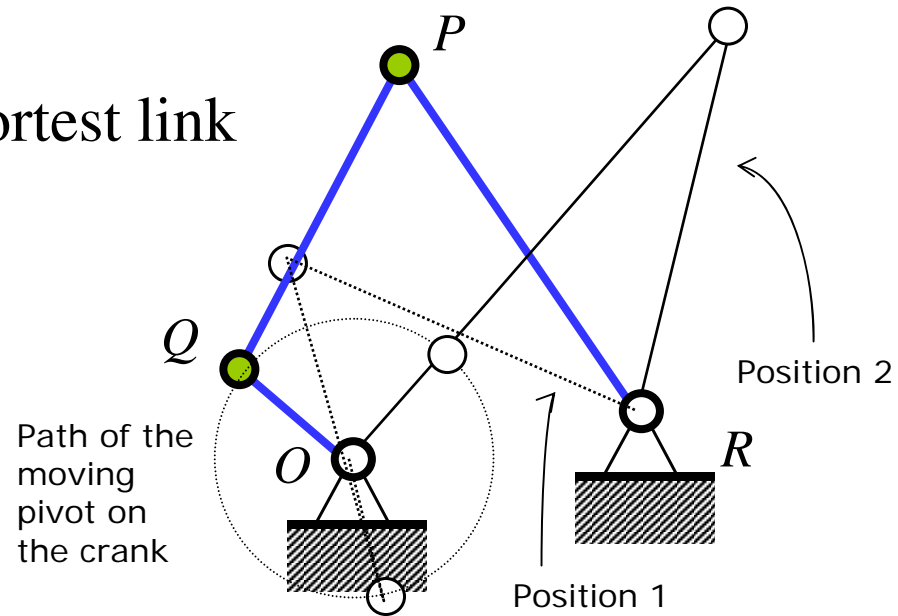




Crank Rocker

$$s + l < p + q$$

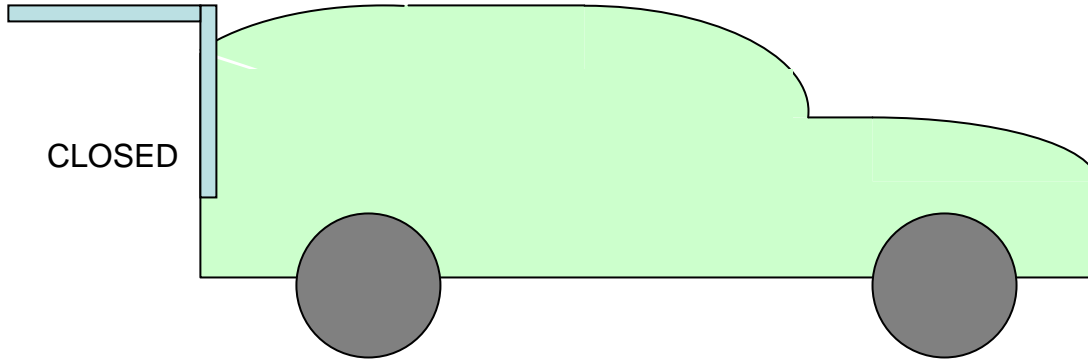
Crank is the shortest link



Synthesis

OPEN

CLOSED

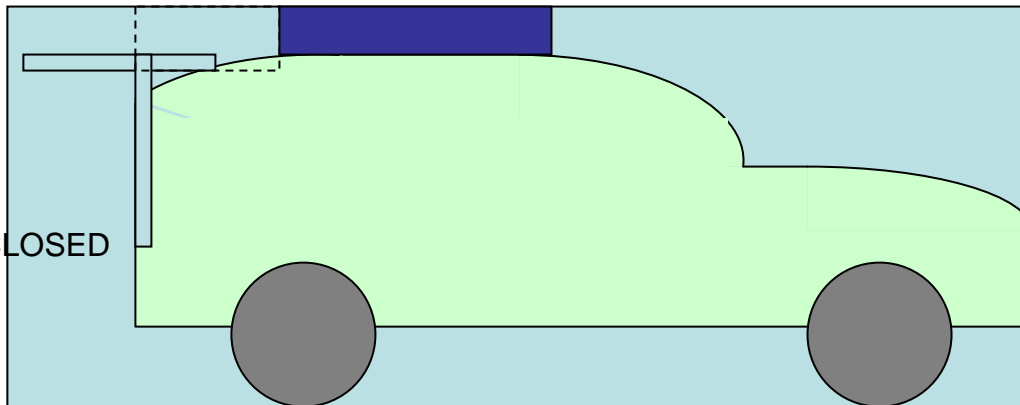


PROBLEM

DOOR IN OLD DESIGN
SWINGS OUT

OPEN

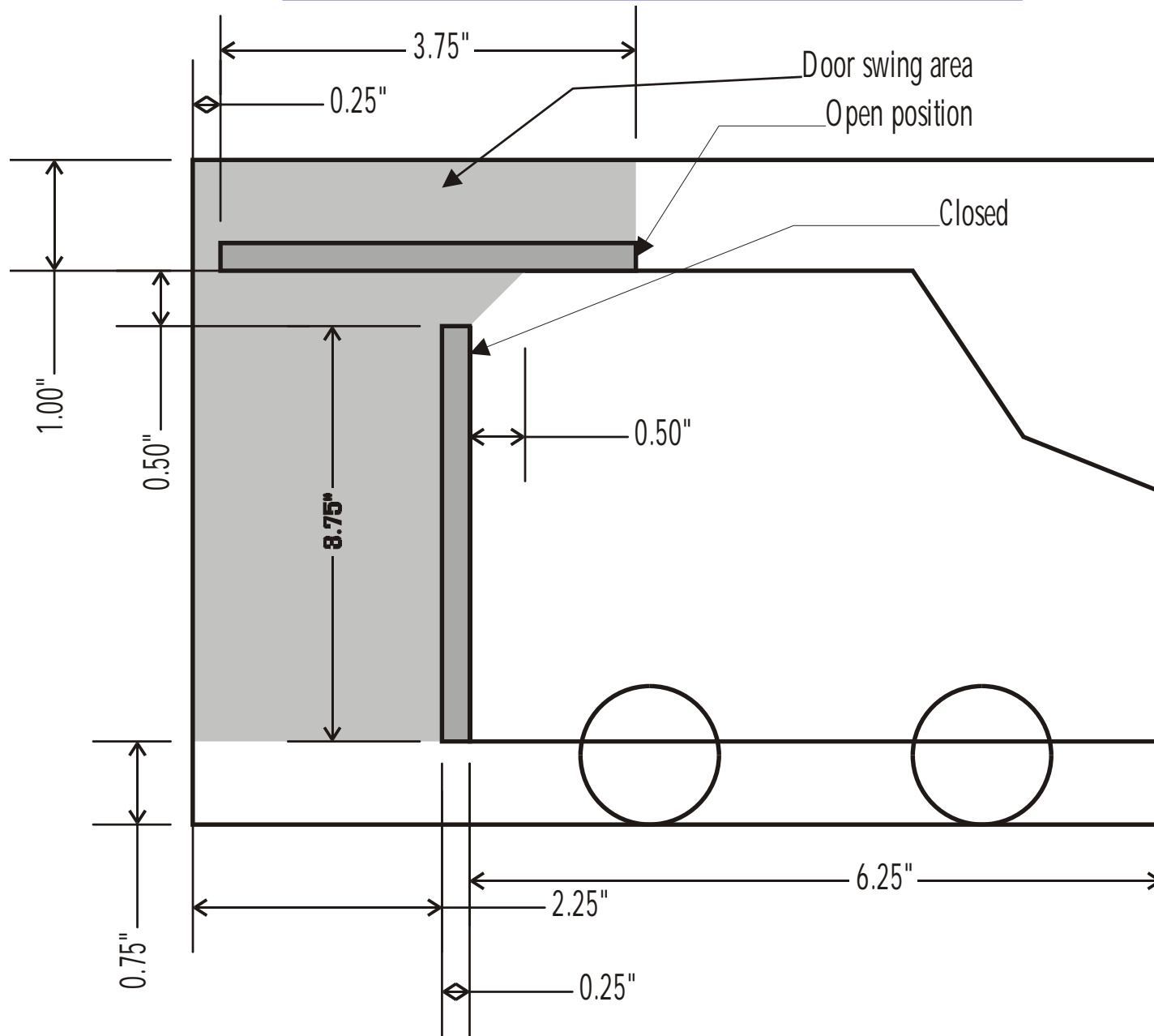
CLOSED



NEED

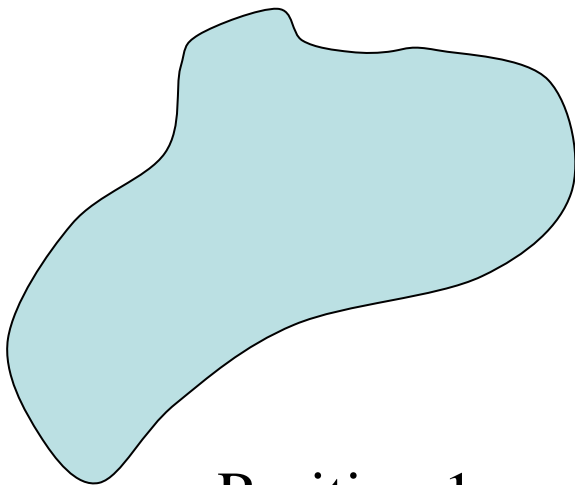
DOOR IN NEW DESIGN
SWINGS OUT 40% LESS

MEAM 211

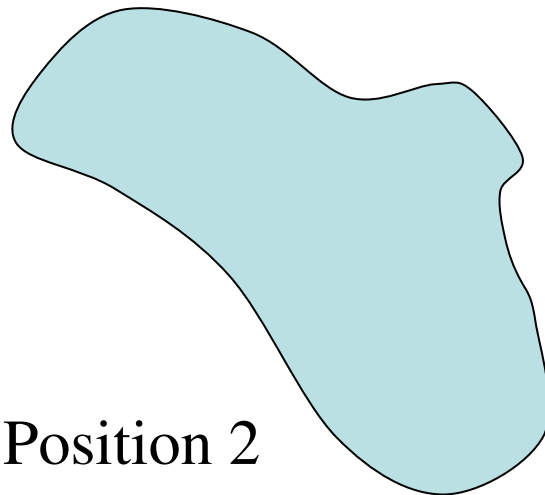


Two-Position Synthesis of Linkages

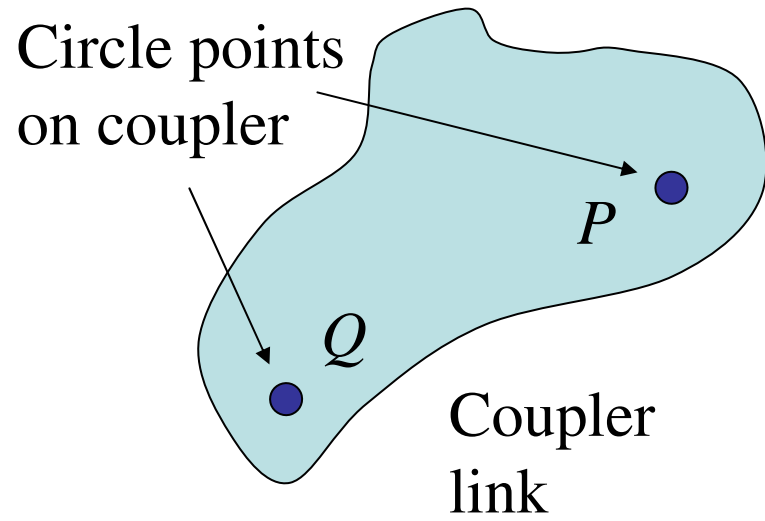
Find a four bar linkage whose coupler, when attached to a specified rigid body, guides the rigid body between two given positions (and orientations).

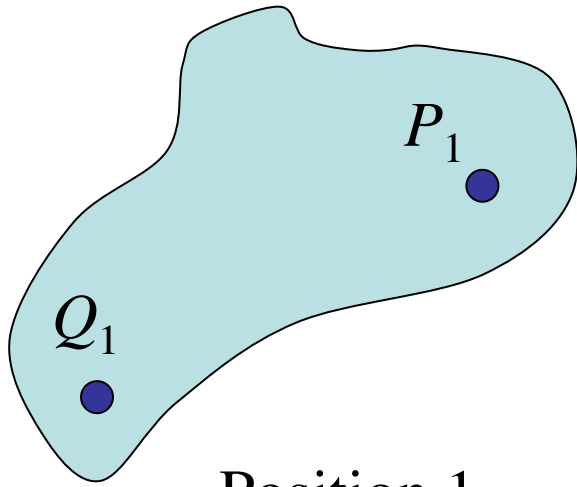


Position 1

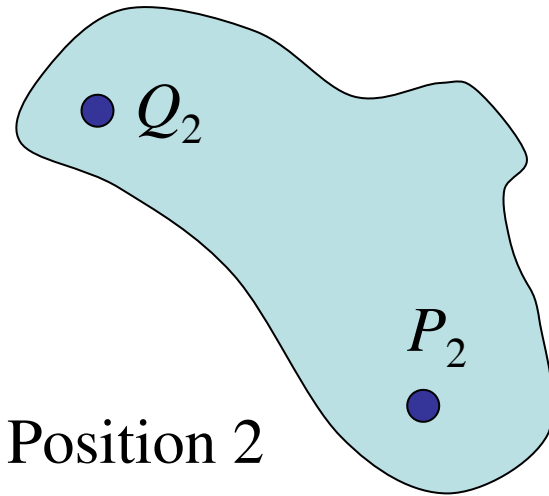


Position 2

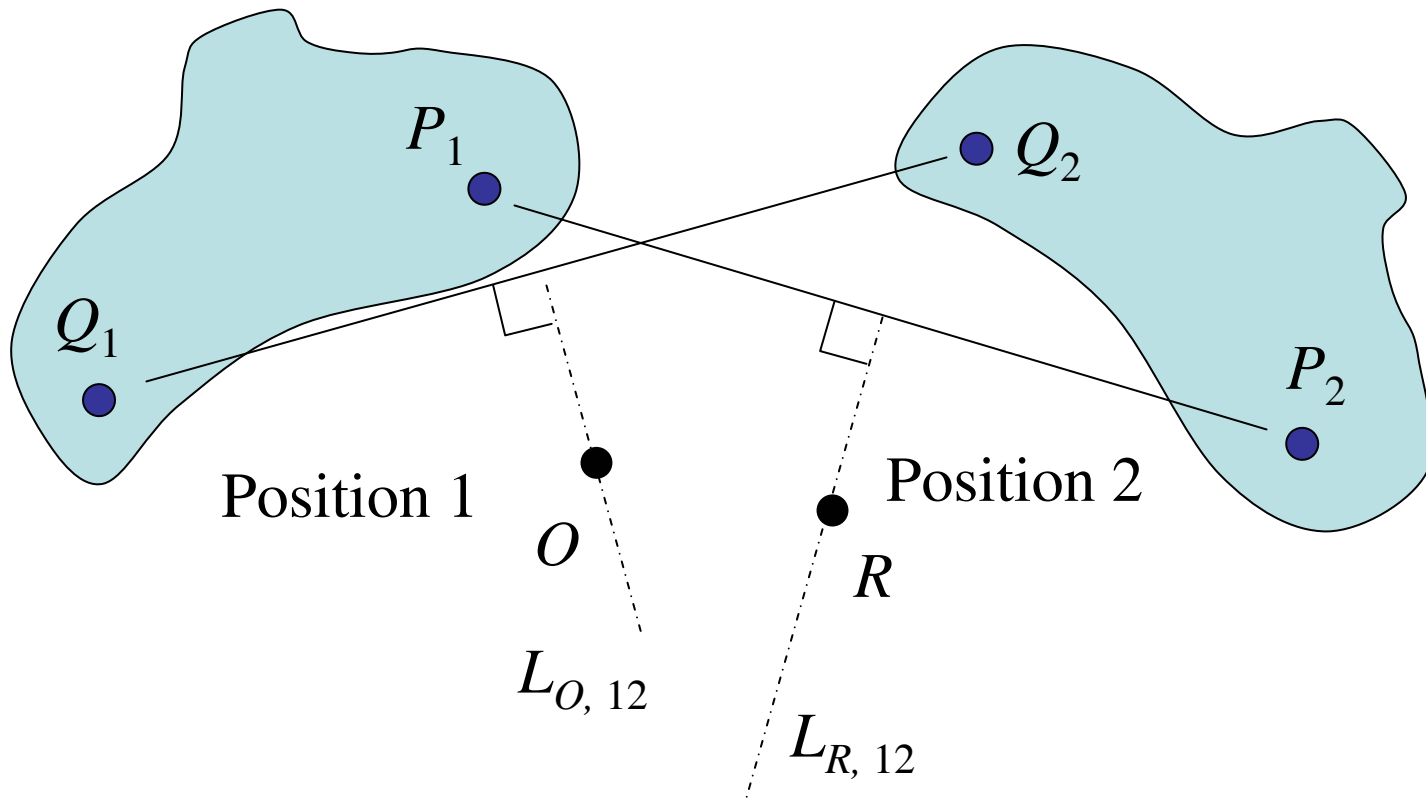


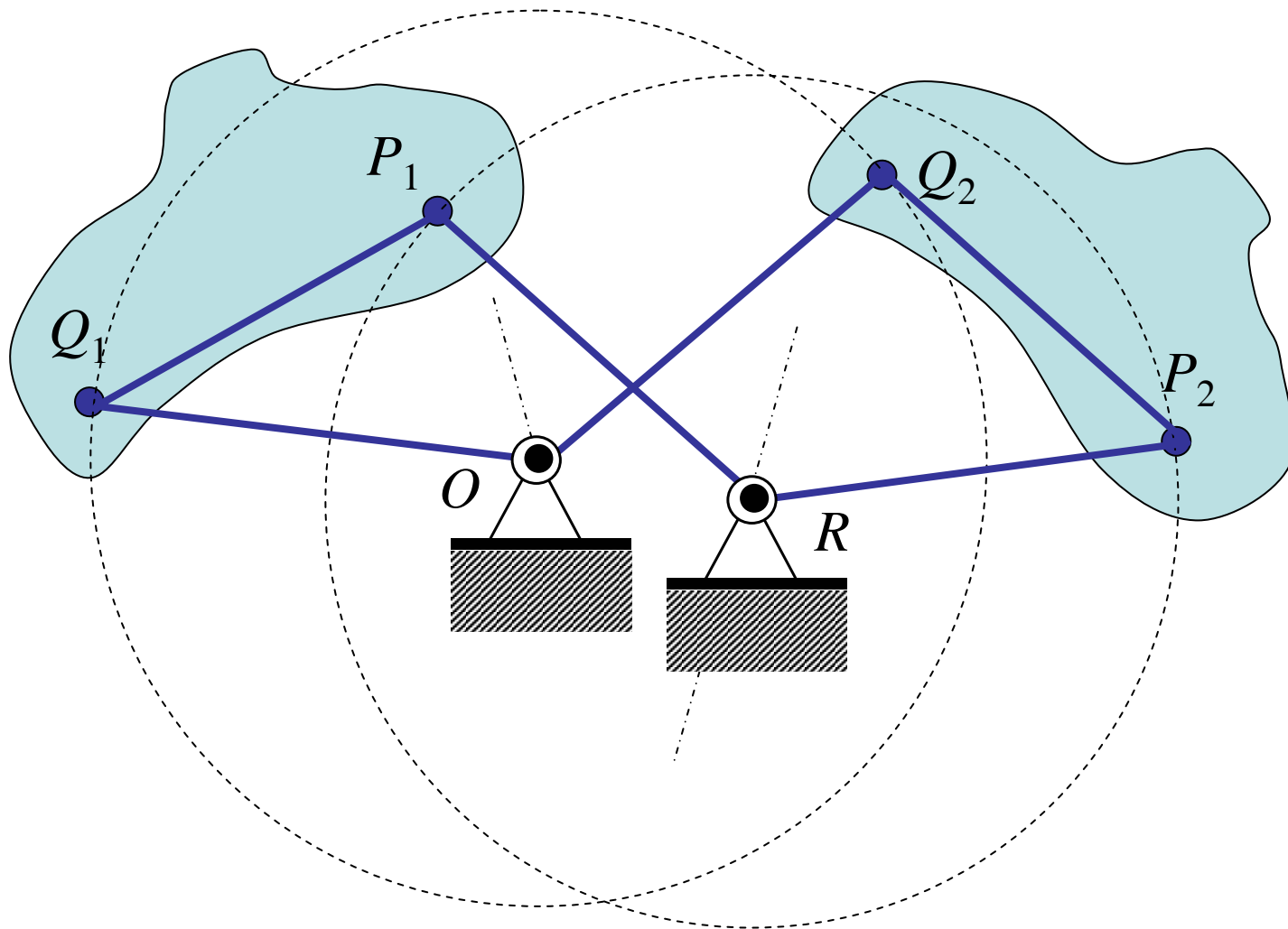


Position 1

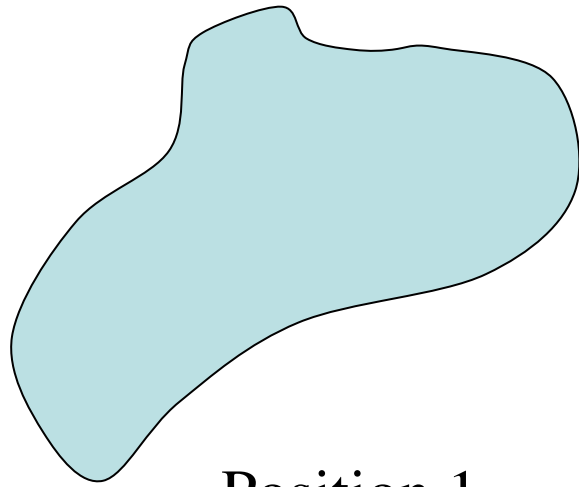


Position 2

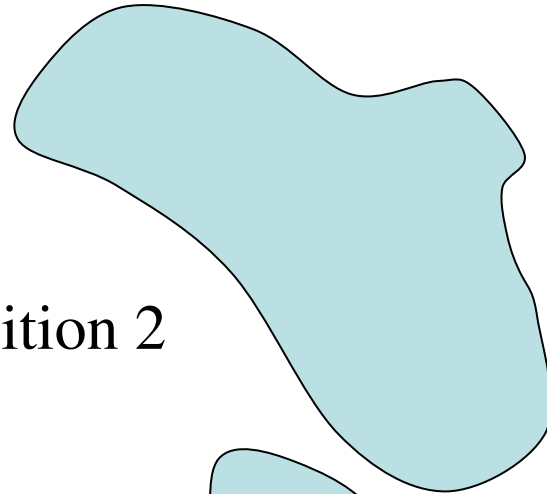




Three-Position Synthesis of Linkages



Position 1



Position 2



Position 3

