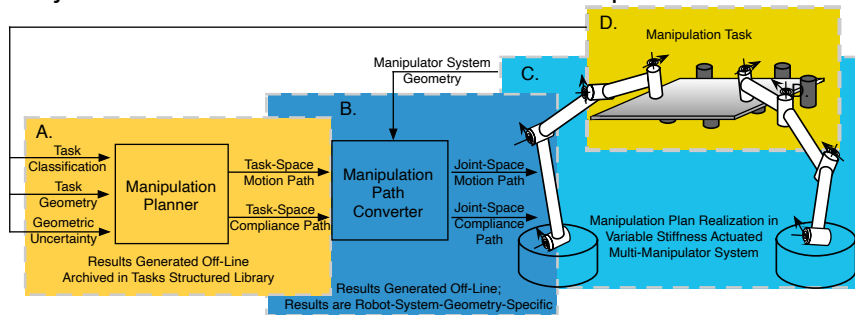


NRI: FDN: Dexterous Manipulation using Multi-Serial Manipulator Systems with Real-time Compliance Modulation, Grant #: 2024534

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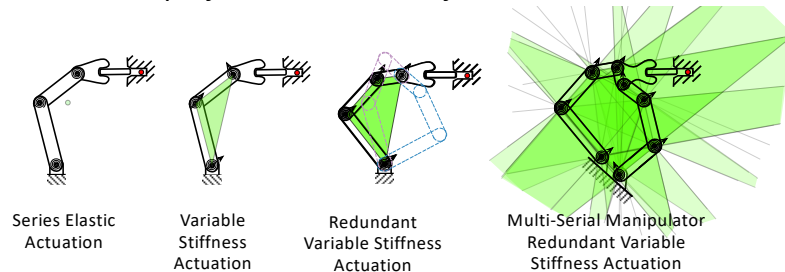
Challenge

- Achieve robot dexterity in **any** constrained manipulation task
- Need task-appropriate passive compliance that can be readily adjusted in real-time for fast constrained manipulation



Problem

- Single serial manipulator compliant systems have very restricted set of achievable compliant behaviors in which compliant centers can not be projected outside the joint set convex hull



Solution

- Realize much larger set of passive compliant behaviors using multi-serial manipulator systems
- Variable stiffness actuation used in each manipulator allows both position control and stiffness modulation of each joint

Scientific Impact

- Develop procedures to synthesize any desired compliant behavior by specifying joint locations and joint stiffnesses when each manipulator is:
 - rigidly coupled to part (multi-serial manipulator systems in figures on left)
 - making point contact with part (compliant hand in figure below)
- Develop procedures to track a position/compliance trajectory for kinematic and actuator redundant systems
- Design and test a planar robot hand that is
 - tendon driven
 - antagonistically actuated with
 - quadratic springs
 to demonstrate manipulation 8x faster w/ lower contact forces

Broader Impact

- Allows robot manipulation in any constrained task involving:
 - large/heavy objects (with multi-arm system)
 - small/fragile objects (with multi-finger system)
- Areas of application:
 - senior assistance (food preparation, cleaning, etc)
 - manufacturing (assembly, material handling, etc)
 - agriculture (picking/handling fruit/vegetables)
 - nuclear remediation
 - ordnance disposal
- Funding supports 3 graduate students (1 Ph.D., 2 M.S.)
- Conference compliance workshop
- Work in manufacturing complements new FASN advanced manufacturing center at Marquette

