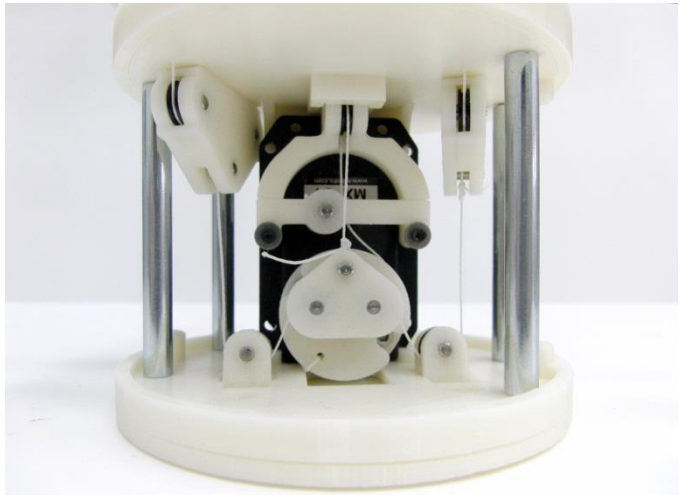
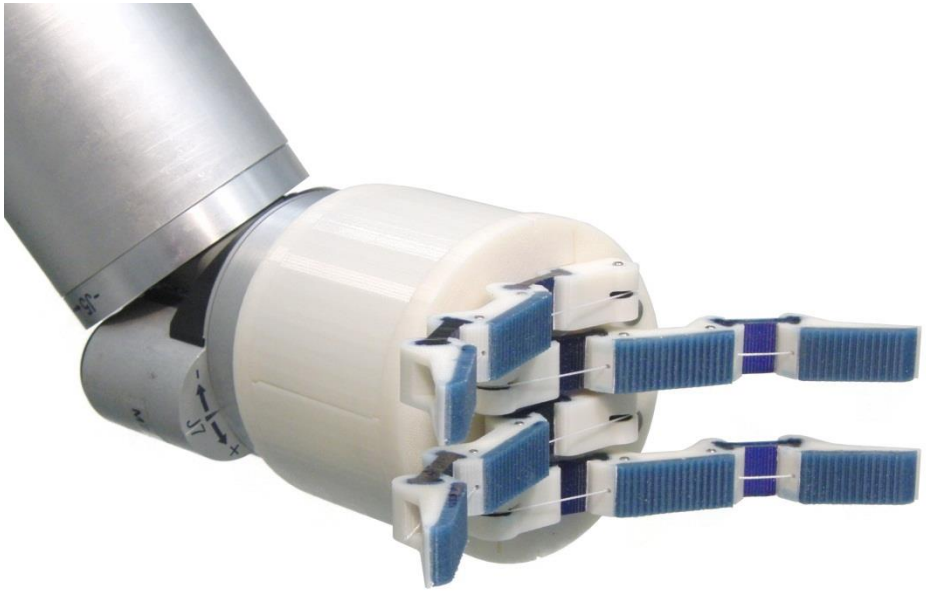
Fabrication/Assembly Instructions

Model T

Ver 0.4

Overview





McMaster Parts List

- Ø1/8”, *L*3/8” dowel pin (**P1**)
  - #97395A35 (8x)
- Ø1/8”, *L*5/8” dowel pin (**P2**)
  - #97395A445 (12x)
- Nylon Pulley (**J1**)
  - #3434T31 (12x)
- Ø1/4”, L2-1/2” zinc-plated female standoffs (**S1**)
  - #92474A029 (4x)

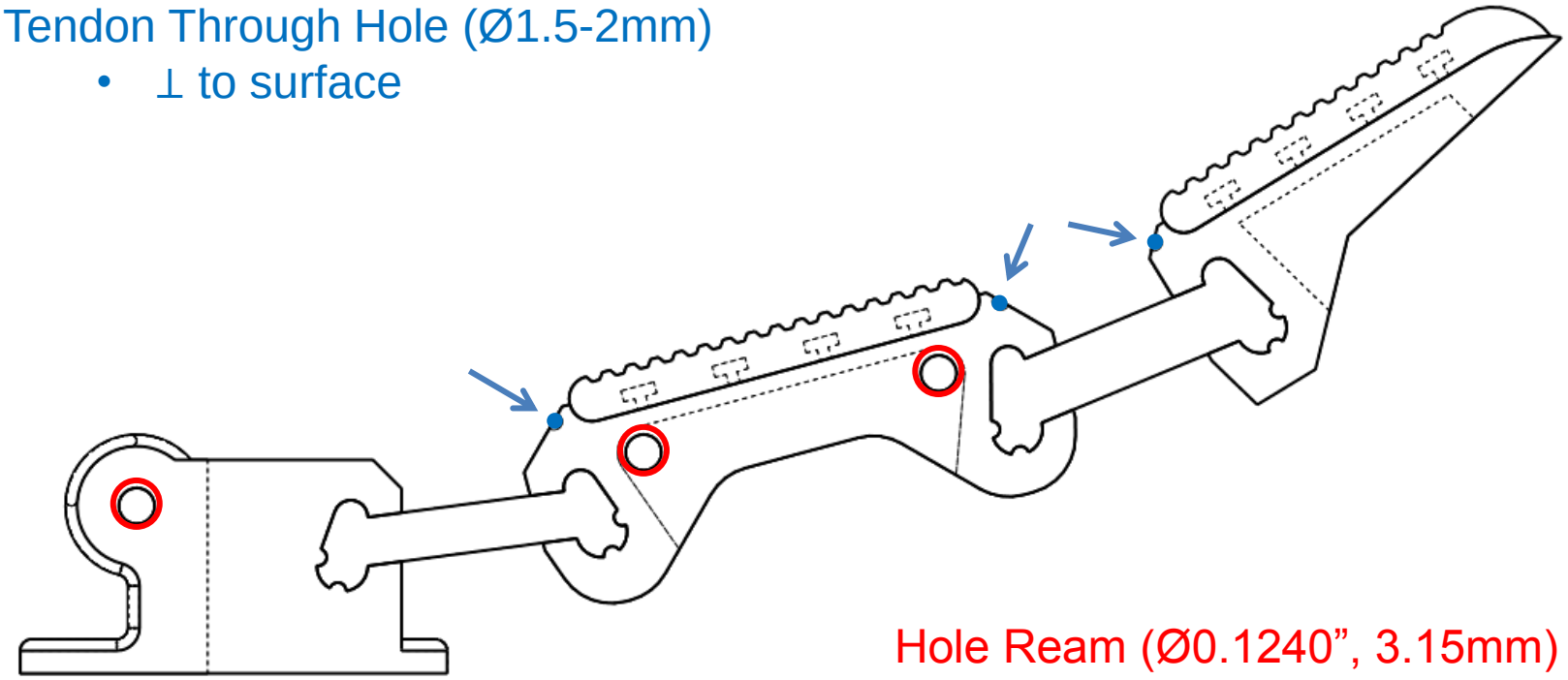
3D Printer Requirements

- Current model only tested on Stratasys Dimension uPrint
  - Layer thickness: 0.254 mm (0.010 in)
  - Model material: ABS
  - Support material? Yes
- Not recommended to use PLA or alternative materials for RP parts
- Majority of parts are designed to not require support material
- Authors do not know how well alternate 3D printers will produce adequate components

Finger Assembly - Prep

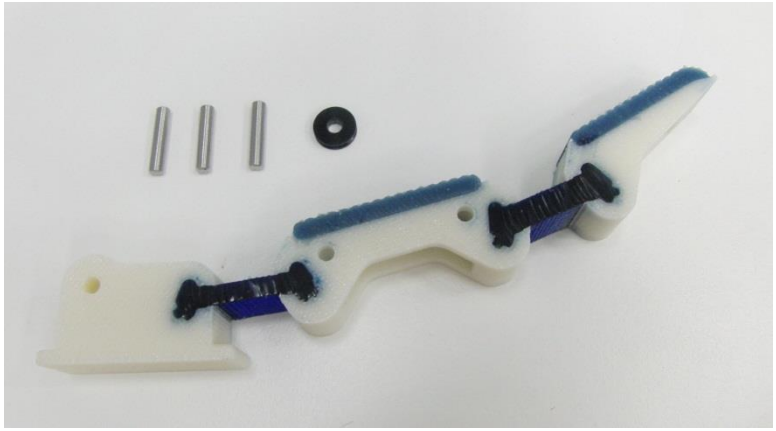
Tendon Through Hole (Ø1.5-2mm)

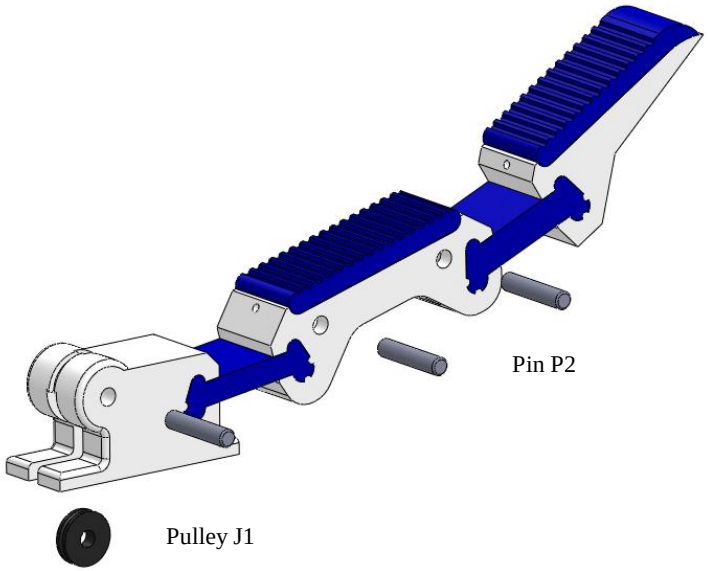
- ⊥ to surface



Hole Ream (Ø0.1240”, 3.15mm)

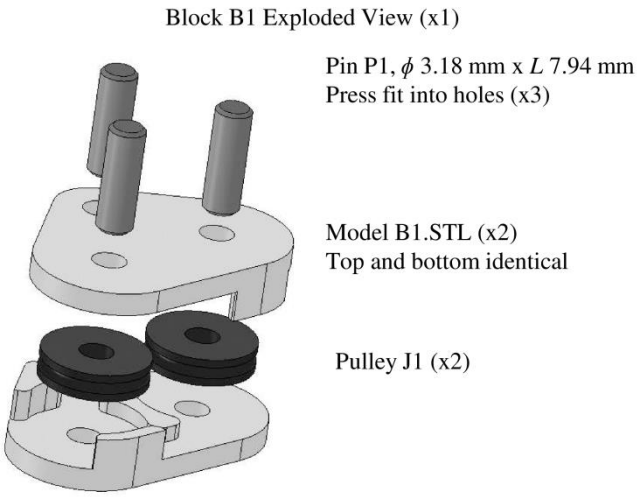
Finger Assembly (x4)





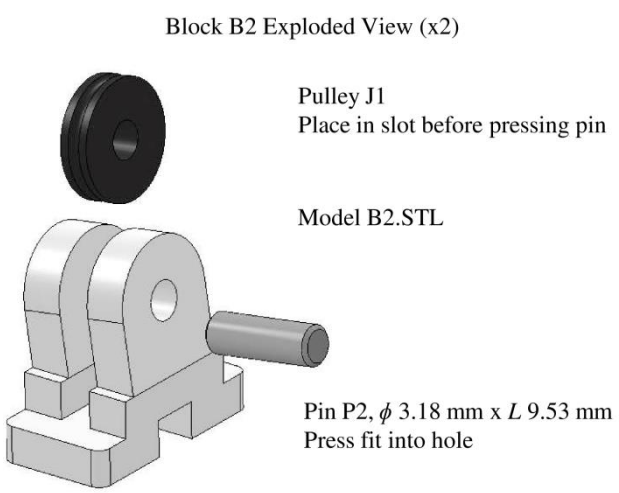
- Components:
  - Rapid-prototype (RP) finger
  - P2 (3x)
  - J1 (1x)
- Press-fit assembly
  - Tendon holes should not be obstructed by pins P2 after assembly

Drive Block B1 Assembly



- Components:
  - B1.stl (2x)
  - P1 (3x)
  - J1 (2x)
- Press-fit assembly
  - Offset design should ensure that pulleys J1 spin freely after assembly

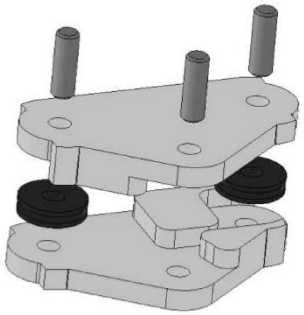
Base Block B2 (2x) Assembly



- Components (per block):
  - B2.stl (1x)
  - P2 (1x)
  - J1 (1x)
- Press-fit assembly
  - Use shim with pulley J1 during assembly so that press-fit of pin P2 doesn't cause sides of B2.stl to pinch on J1
  - Pulley J1 should spin freely after assembly

Differential Block B3 (2x) Assembly

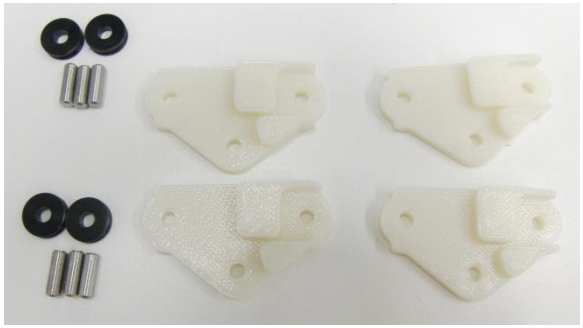
Block B3 Exploded View (x2)

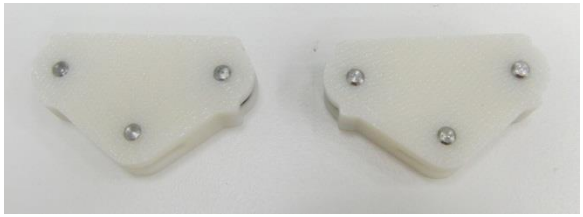


Pin P1, ϕ 3.18 mm x L 7.94 mm
Press fit into holes (x3)

Model B3.STL (x2)
Top and bottom identical

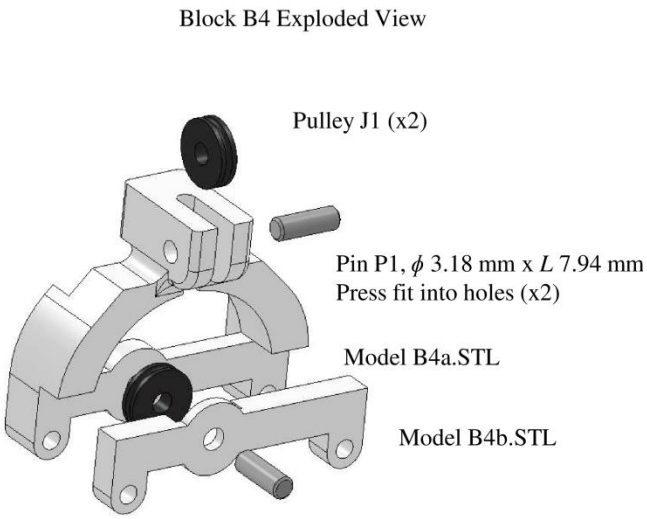
Pulley J1 (x2)





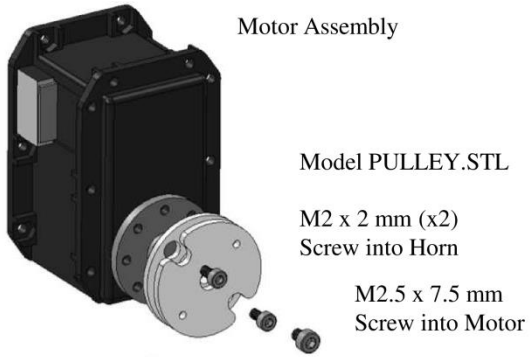
- Components (per block):
  - B3.stl (2x)
  - Pulley J1 (2x)
  - Pin P1 (3x)
- Press-fit assembly

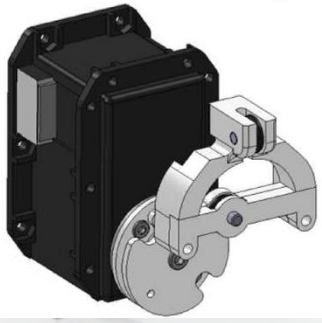
Motor Block B4 Assembly

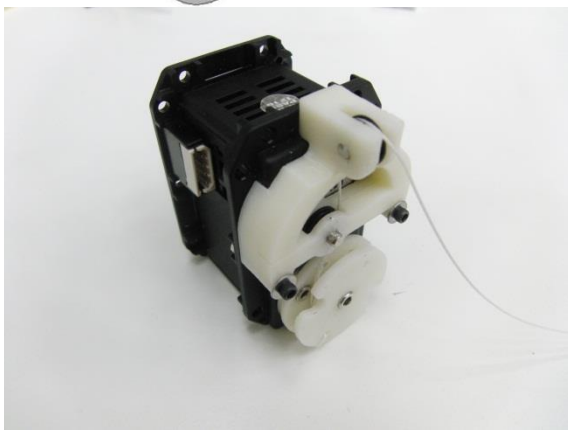


- Components:
  - B4a.stl
  - B4b.stl
  - P1 (2x)
  - J1 (2x)
- Press-fit assembly
  - Minor filing may be needed to ensure that pulleys spin freely after assembly
  - Useful to use shim when assembling top pulley J1 to avoid pinching when pressing pin P1

Motor Block Assembly

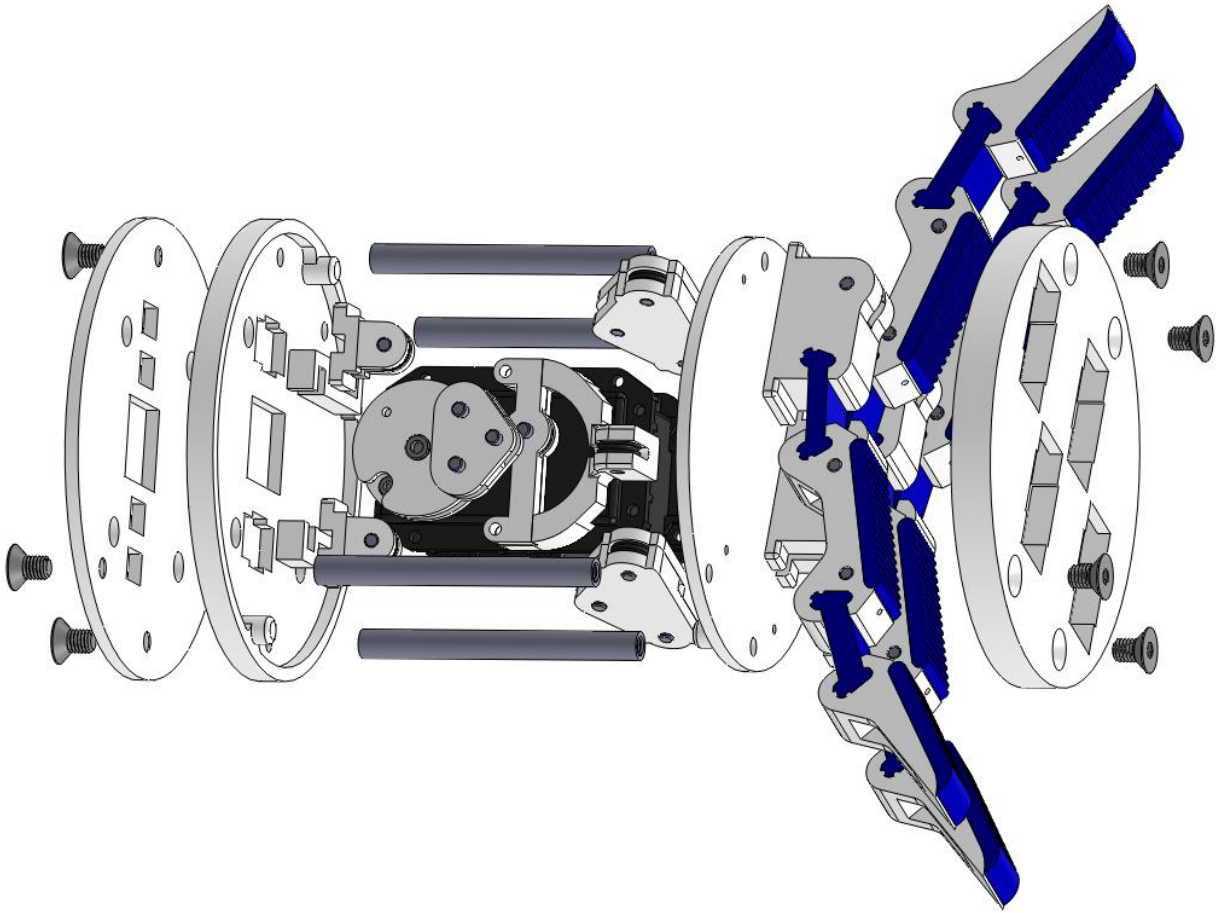




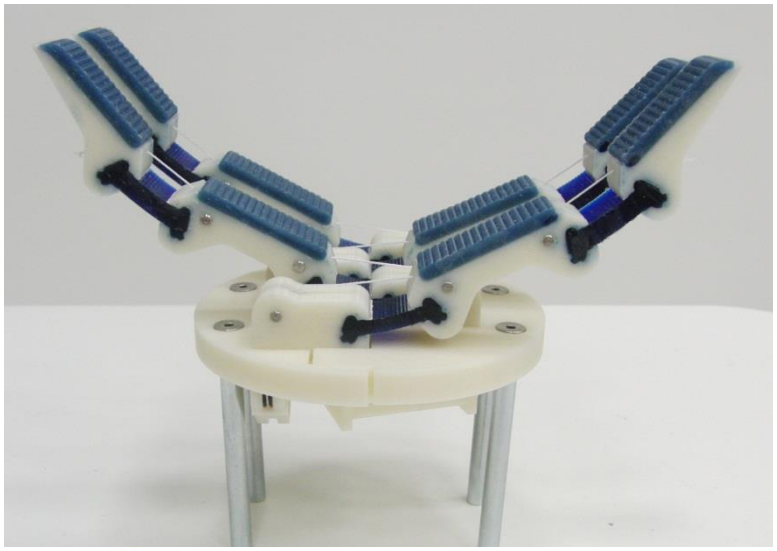


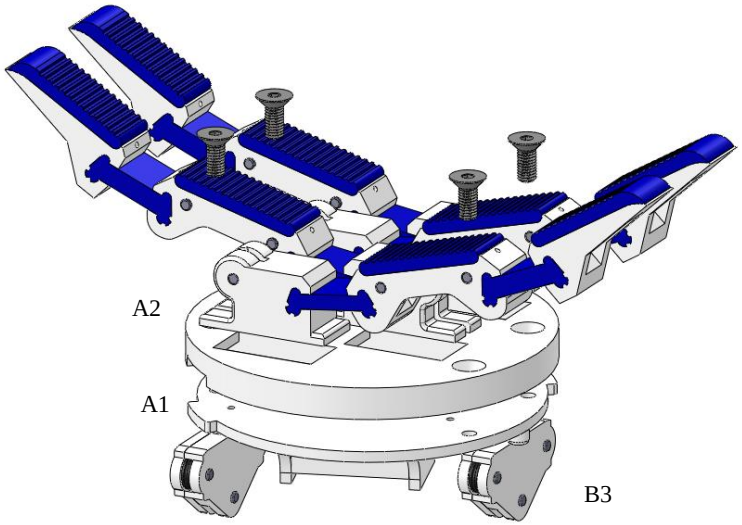
- Components:
  - Dynamixel MX-64
  - PULLEY.stl
  - M2 *L*2mm screw (2x)
  - M2.5 *L*7.5mm screw (1x)
- Block B4 may be attached with any appropriately-sized set of bolts/nuts
- Improved clinch knot used in prototype tests to affix tendon to drive pulley

Frame Assembly Overview



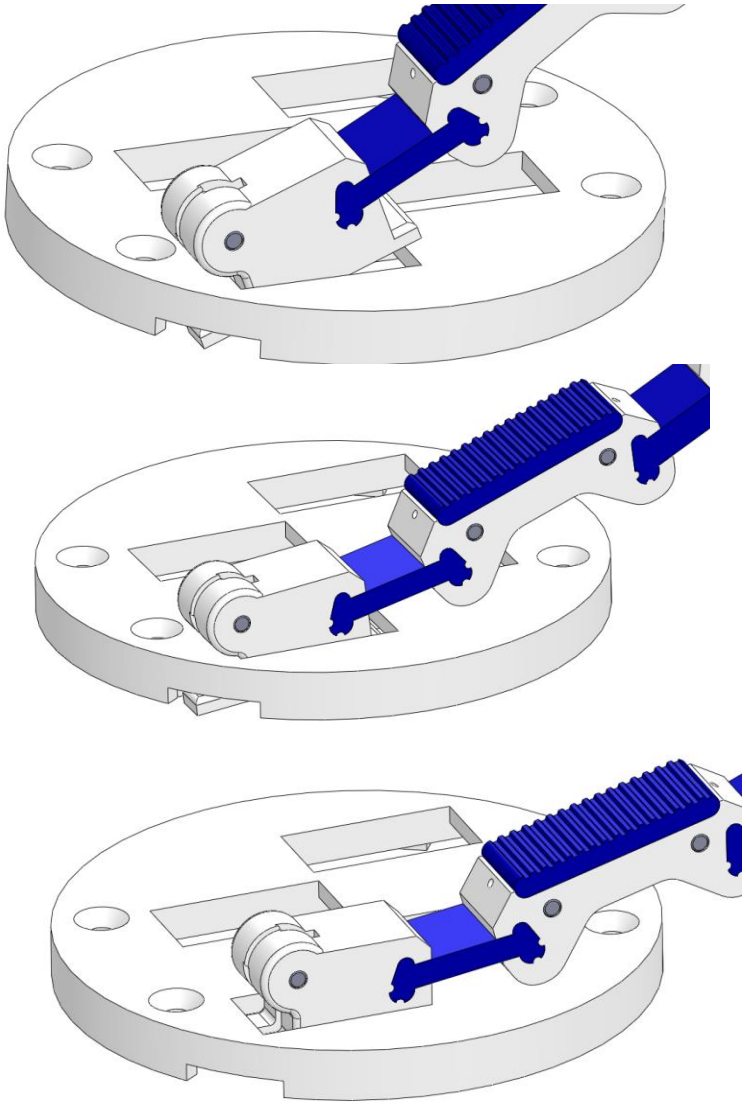
Frame Top Assembly Overview





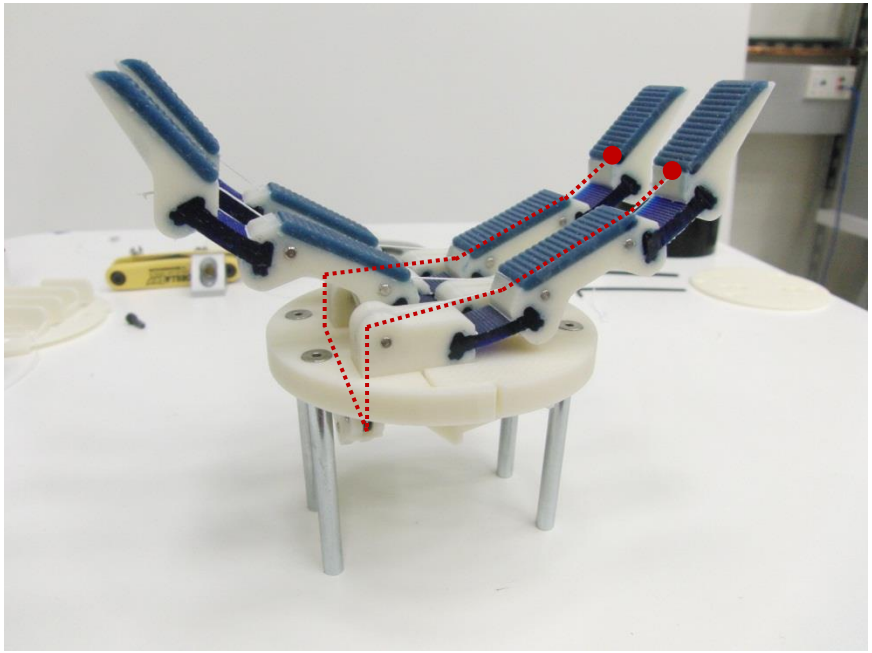
- Top and bottom frame held by standoffs S1
- Plates A1.stl and A2.stl clamp finger bases in fixed configuration
  - Notches specify how A1 and A2 align with each other
- Fixed tendons tied between fingers and differential block on same side of grasps

Frame Top Assembly - Fingers



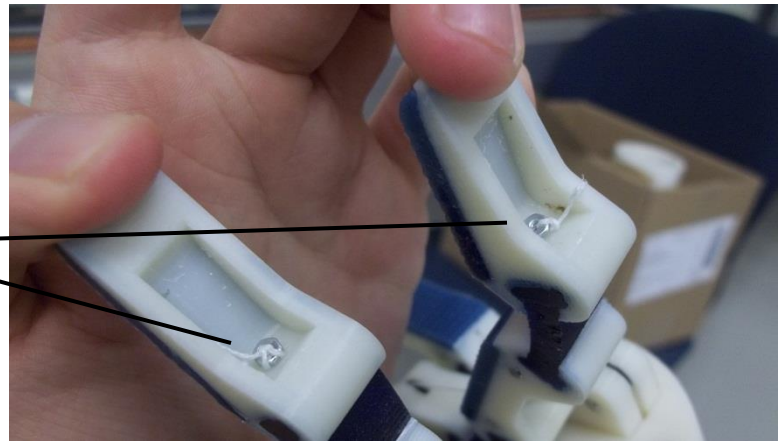
- Fingers inserted from above
  - Slide down at an angle
  - Snap into recesses on bottom layer of A2.stl
- Fingers should snap rigidly in place
  - In absence of fasteners or clamping

Frame Top Assembly - Tendons

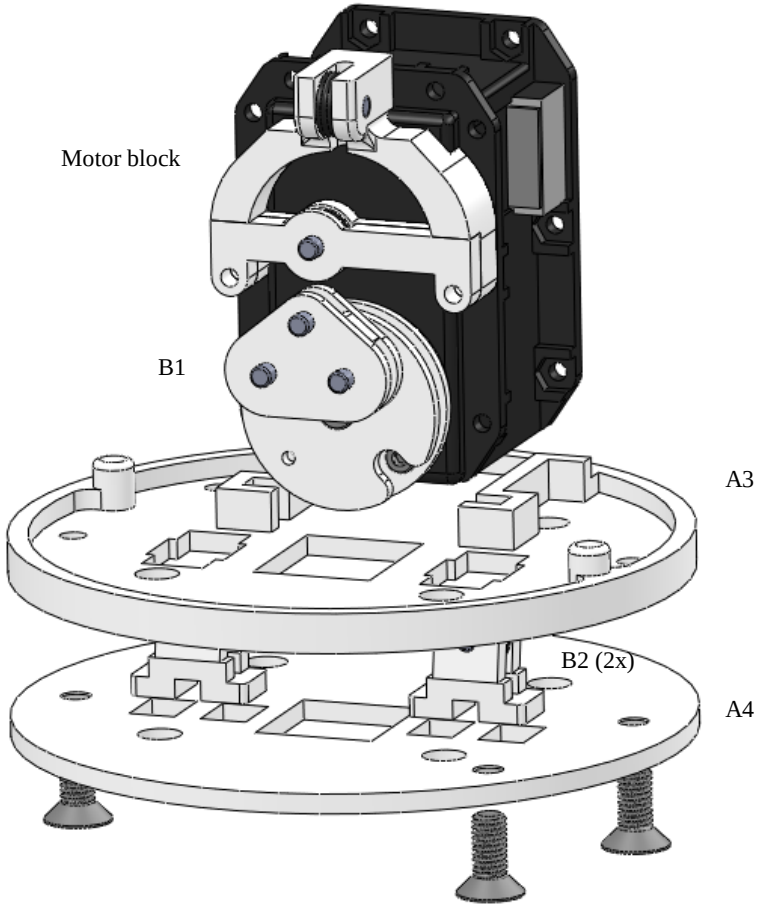


- Tendon terminates at distal end of finger pairs
  - Tendon should be pulled tight by joint stiffnesses
- Helpful to pre-load fingers during tendon attachment for more slack

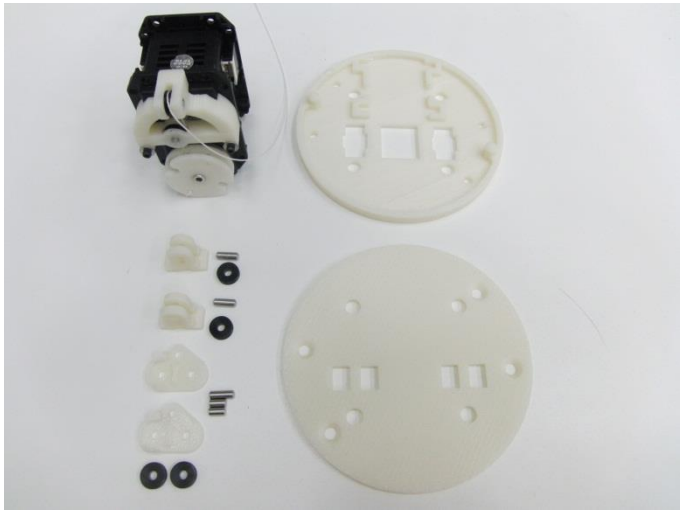
Tendon termination points



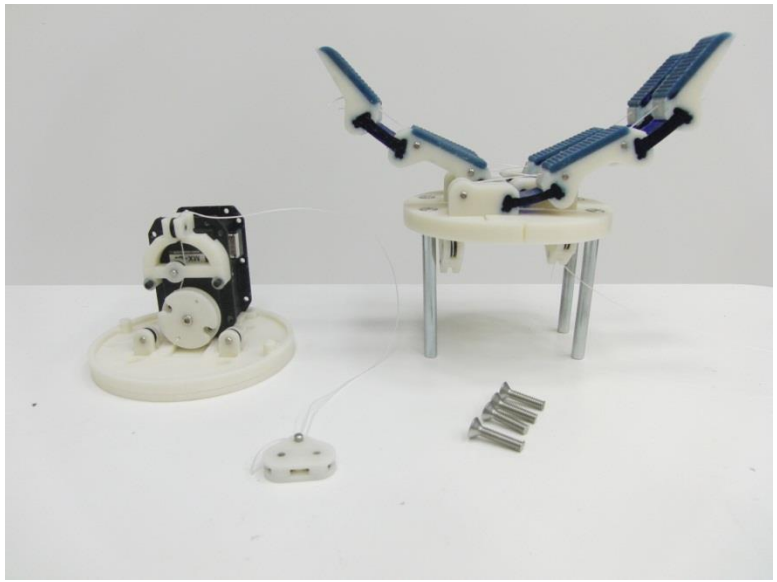
Frame Bottom Assembly Overview



- No fasteners needed for motor block
- A3 and A4 used to clamp pulley blocks B2 in place
  - Motor and B2 blocks should snap into place

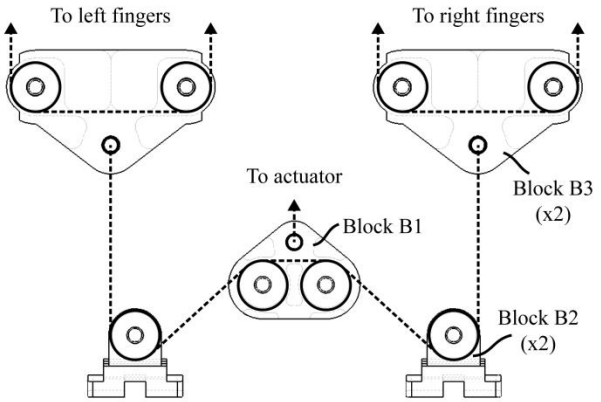


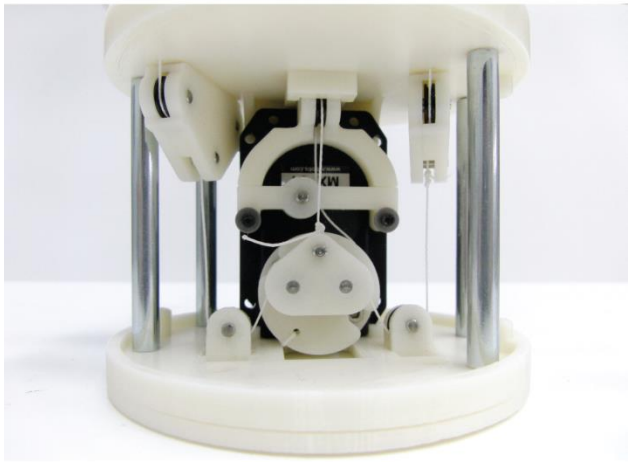
Final Frame Assembly



- A1 snaps onto top of block B4 to pin frame in correct orientation
- Standoffs S1 used to fix top and bottom frame assemblies
- Final tendon attachment is performed at very end
  - To simplify assembly, tendon between actuation pulley and drive pulley block B1 can be left slack

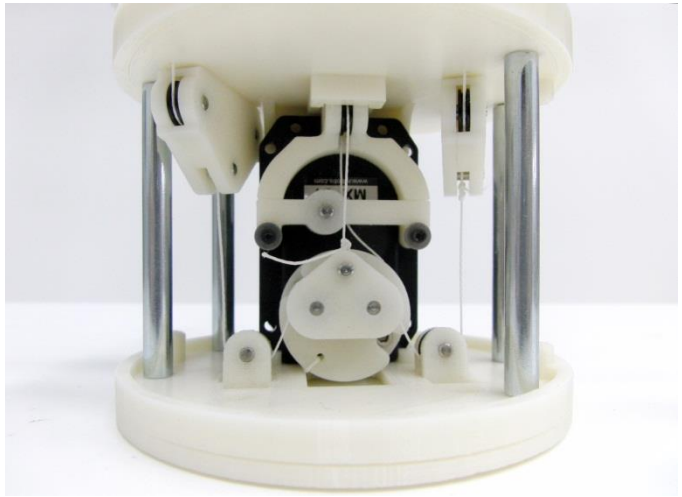
Differential Tendon





- Connect final actuation tendon between two differential blocks B3
  - Route tendon through pulley blocks B2 and actuation pulley block B1
- Tendon should be tied taut with actuation pulley block B1 pinned as close to the bottom frame as possible
  - Fingers can be preloaded to provide additional slack to simplify tie-off

Servo Actuation Zero



- Actuation tendon between drive pulley and block B1 needs to be taut at servo zero position

1. Drive servo to zero position
2. Loosen M2, M2.5 attachment screws such that drive pulley spins loosely
3. Re-affix pulley in position where drive tendon is as taut as possible