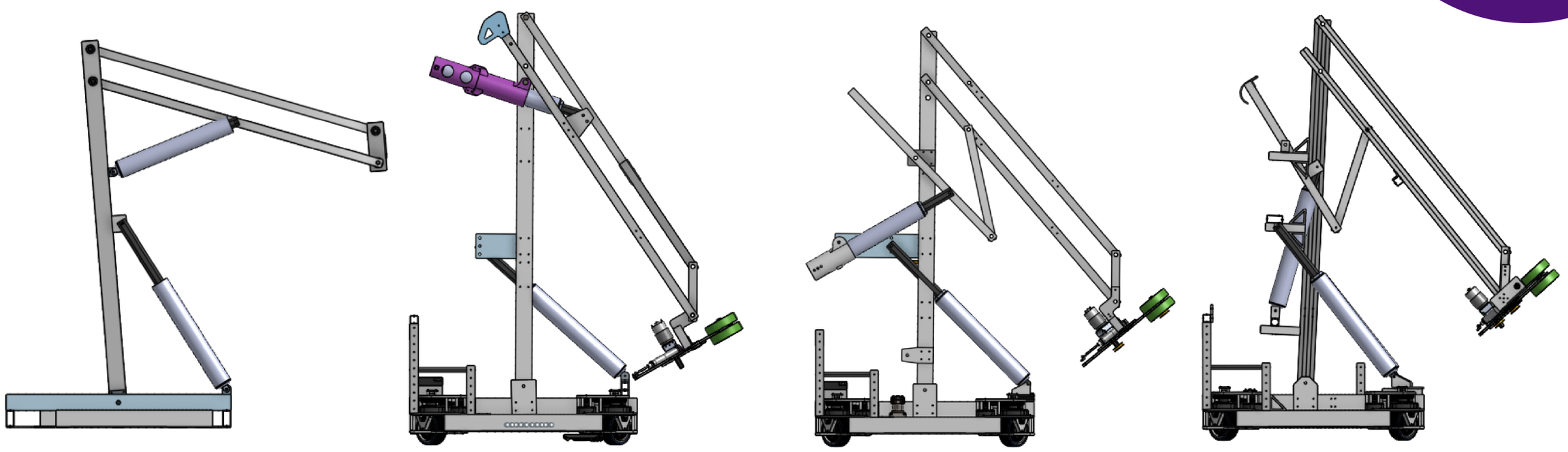
Issaquah Robotics Society

ISSAQUAH ROBOTICS SOCIETY 1318

20TH

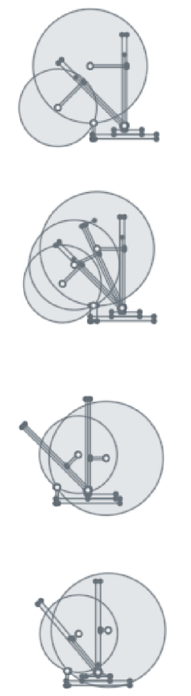
FIRST ROBOTICS COMPETITION

Main Arm Design Evolution

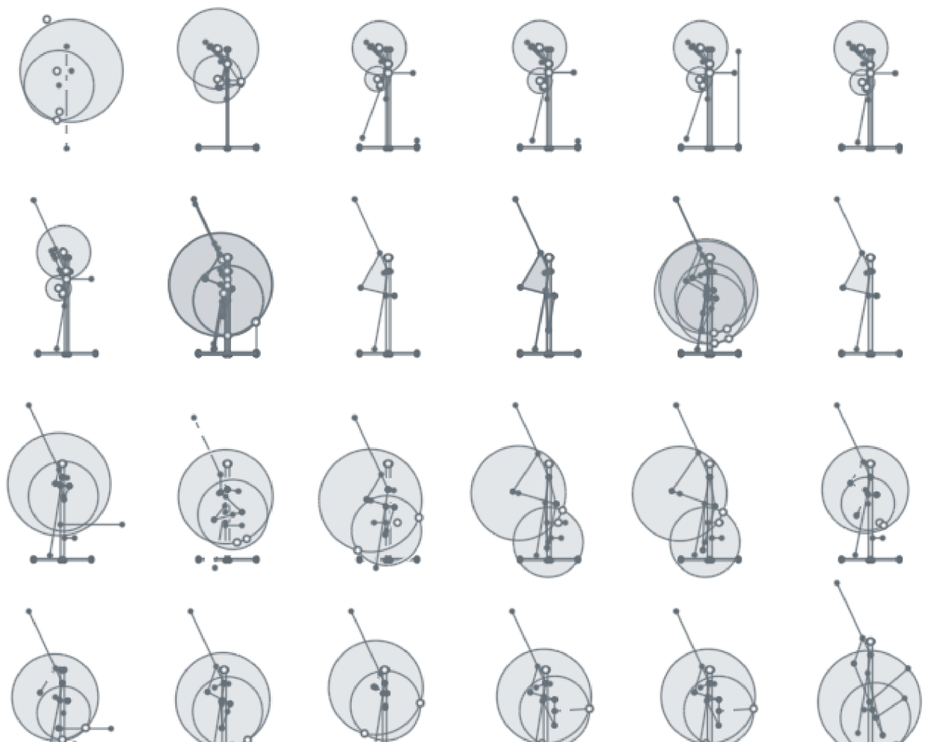


Geometry

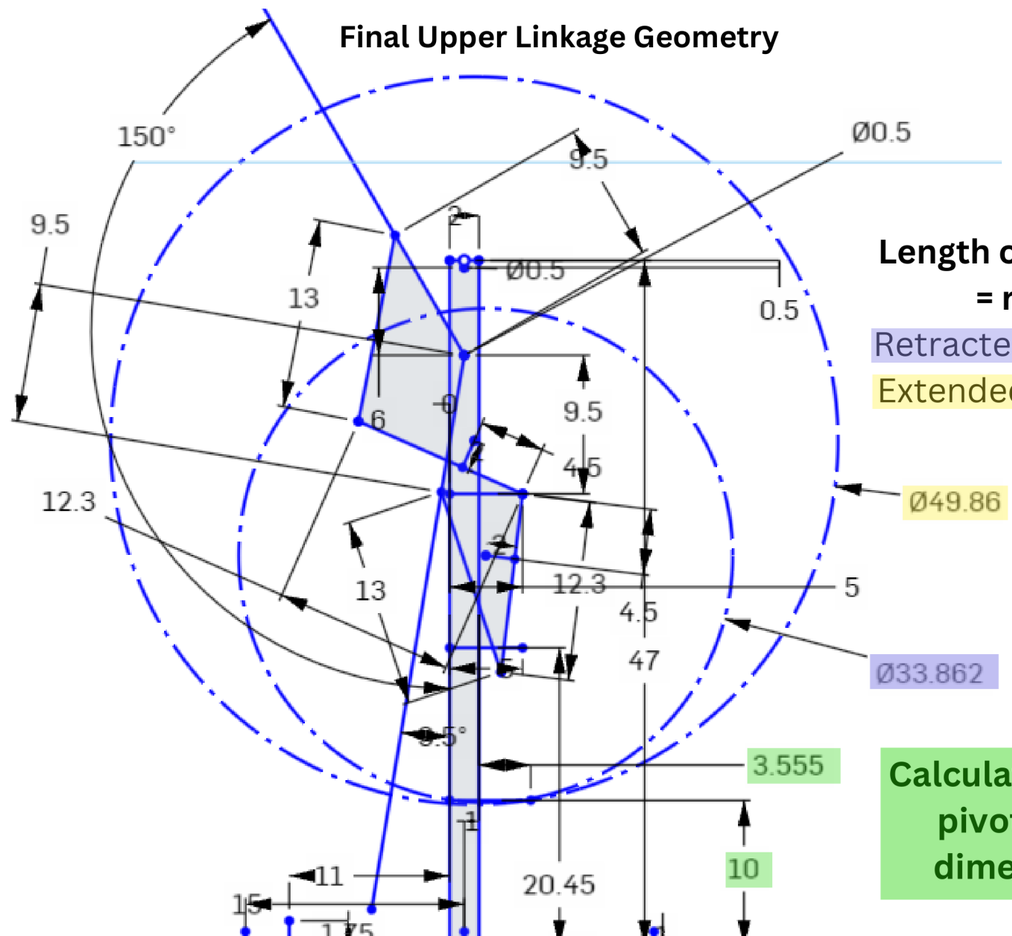
Lower Actuator Geometry Iterations



Upper Linkage Geometry Iterations



Final Upper Linkage Geometry



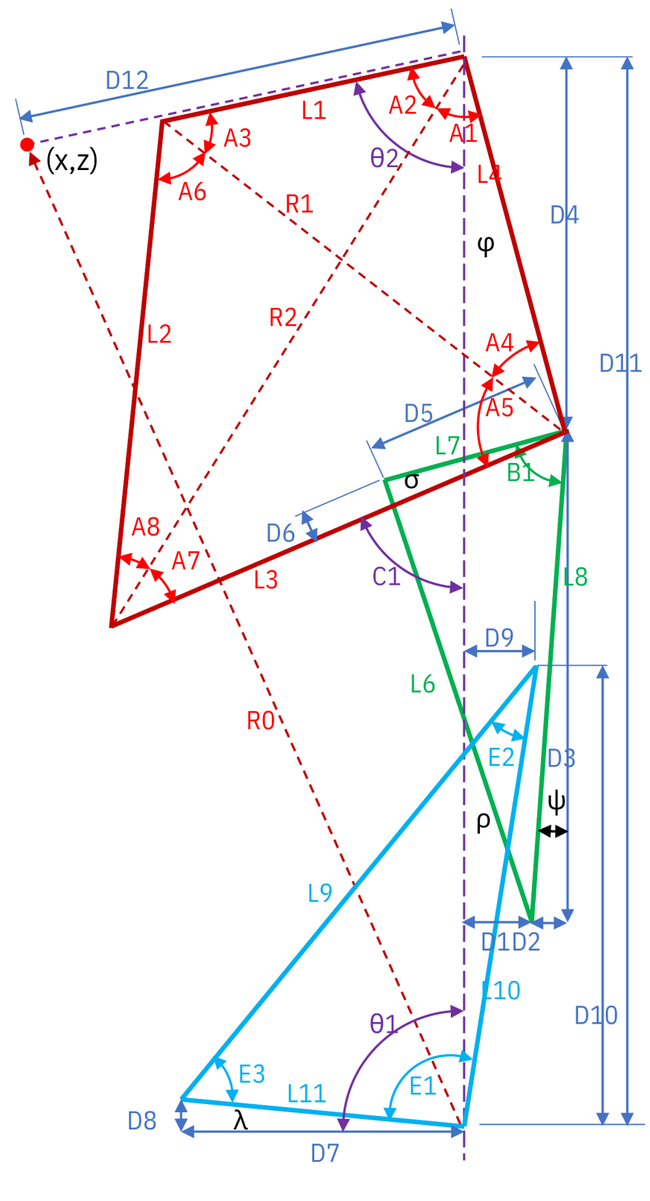
Length of Actuators = radius

Retracted (radius x2)

Extended (radius x2)

Calculated lower pivot point dimensions

Forward and Inverse Kinematics



(Finding L6 and L9, given θ1 and θ2)

(Finding θ1 and θ2 given L6 and L9)

Upper Section Steps:

φ= *atan2*((D1+D2), D4)

A1+A2 = θ2 + φ

R1 = sqrt [L_1^2+$_4$L ^{2} -2*L_1*L_4*cos(A1+A2)]

R2 = sqrt [L223+ L4-2*L3*L4*cos(A4+A5)]

A4 = *asin*(L1*sin(A1+A2)/R1)

A1 = ±*acos*[(L2+ R2-L2423)/(2*L4*R2)]

A5 = ±*acos*[(L2+ R2-L2312)/(2*L3*R1)]

A2 = ±*acos*[(L2+ R2-L2122)/(2*L1*R2)]

θ2 = A1 + A2 -φ

Middle Section Steps:

σ= *atan2* (D6,D5)

Ψ= *atan2* (D2,D3)

C1 = 180°-φ-A4 -A5, B1 = C1 -Ψ+ σ

B1 = ±*acos*[(L227+ L8−$_6^2$)/(2*L7*L8)]

B1 = 180°-A4 -A5 -φ -Ψ + σ

L C1 = B1 + Ψ-σ

L6 = sqrt [L2+ L278-2*L7*L8*cos(B1)]

A4+A5 = 180°-φ-C1

Lower Section Steps:

λ= *atan2* (D8,D7)

ρ= *atan2* (D9,D10)

E1 = θ1 + ρ -λ

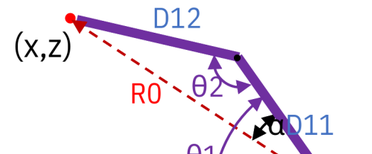
E1 = ±*acos*[(L_{10}^2 + L_{11}^2 - L_9^2)/(2*L10*L_{11})]

L9 = sqrt [L210+ $L_{11}^2$2*L10*L11*cos(E1)]

θ1 = E1 -ρ + λ

Notes:

- D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, and D12 from
- CAD θ1, θ2 from Inverse Kinematics or L6, L9 from actuator inputs



Inverse Kinematics

R22+ z20= x

θ2 = ±acos [(D2+ D2–R2 11120)/(2*D11*D12)]

β= atan2 (z,x)

α= ±acos [(D2+ R2 -D2 11012)/(2*D11*R0)]

θ1 = α+ β

Forward Kinematics

x = D11*cos(θ1) + D12*cos(θ1 -180°+ θ2)

z = D11*sin(θ1) + D12*sin(θ1 -180°+ θ2)