Loop #1

L1 + L2 + L31 - OC = 0

ROA + RAB + RBC – RCO = 0 (1)

ROA = rOA {cosθ, sinθ}

RAB = rAB {cosθA, sinθA}

RBC = rBC {cosθB, sinθB}

RCO = {XC,YC}

Loop #2

OC + L32 + L4 – S – OF = 0

ROC + RCD + RDE - REF - RFO = 0 (2)

RCD = rCD {sinθB, cosθB}

RDE = rDE { cos( + ϕD) , sin( + ϕD) }

REF = rEF {1, 0}

RFO = rFO {0, 1}

Position Projection

Loop #1

rOAcos(θ) + rABcos(θA) + rBCcos(θB) – XC = 0 (X)

rOAsin(θ) + rABsin(θA) + rBCsin(θB) – YC = 0 (Y)

Loop #2

XC + rCDsin(θB) + RDEcos( + ϕD) – rEF = 0 (X)

YC + rCDcos(θB) + RDEsin( + ϕD) – rFO = 0 (Y)

Velocity Projection

Loop #1

-rOAsin(θ) - rABAsin(θA) - rBCBsin(θB) = 0 (X)

rOAcos(θ) + rABAcos(θA) + rBCBcos(θB) = 0 (Y)

Loop #2

rCDBcos(θB) - rDEDsin( + ϕD) = 0 (X)

-rCDBsin(θB) + rDEDcos ( + ϕD) = 0 (Y)

Acceleration Projection

Loop #1

-rOAsin(θ)-rOA2cos(θ) - rABAsin(θA) - rAB2Acos(θA) - rBCBsin(θB) - rBC2Bcos(θB) = 0 (X)

rOAcos(θ) -rOA2sin(θ) + rABAcos(θA) - rAB2Asin(θA) + rBCBcos(θB) - rBC2Bsin(θB) = 0 (Y)

Loop #2

rCDBcos(θB) - rCD2Bsin(θB) - rDEDsin( + ϕD) - rDE2Dcos( + ϕD) = 0 (X)

-rCDBsin(θB) - rCD2Bcos(θB) + rDEDcos( + ϕD) - rDE2Dsin( + ϕD) = 0 (Y)