ME192 HW #5 Solutions

10-8-14

4.8) **4 points**

Two possibilities Infinite possibilities

4.14) **4 points**

All 3 degrees of freedom robots have a closed form solution(s) and can be solved with Pieper’s

solution method.

4.16) **6 points**

Since α1=0 or sinα1=0, z= k4 per (4.50) with K4 defined in (4.51),

4Pz= 1.707 = f3 cosα1 + d2 cosα1 = f3 = a3 sinα2sinθ3 + d3 cosα2 = sinθ3 + 1

Therefore **θ3 = 45° or 135°** for θ3 within ±180°.

4.17) **6 points**

Since a1=0, r = k3 per (4.50) with K3 defined in (4.51),

r = x2 + y2 + z2 = 3 = f12+f22+f32+a12+d22+2d2f3 = 3 + 2 f3

Therefore f3 = 0 = sin 45 sin θ3 –d3 cos 45 = (sin θ3 + 1)/)

Therefore **θ3 = -90°** for θ3 within ±180°.

**--------------------------**

**Extra 5 points**

With θ3 fixed, f1 = cos (-90) = 0 and f2 = - from (4.45).

g3 = z from (4.46) and Z = as given.

With f1, f2, and f3 all found, g3 = = - cos θ2 f2 = cos θ2. from (4.47).

Therefore θ2 = 0°.

px = x = 0 as given and also px = c1g1 – s2g2 from (4.47).

Evaluating px = - sin θ1 = 0.

Therefore θ1 = 0°.

The stick configuration of the robot is as below:

(Not needed to show)

Z

P=(0, 1, 1.4142)

**Θ = (0, 0, -90)**

X

Y