**Two-dimensional position, velocity and acceleration solutions**

**Kinematically driven motion**

1.0 Initialize

 1.1 constants

 1.2 global locations of fixed points 

 1.3 local blueprint locations 

2.0 Initial estimates

 2.1 global locations of origins 

 2.2 orientation angles 

 2.3 assemble into

3.0 Explicit time loop

4.0 Position solution

 4.1 rip new values for  and  from 

 4.2 form attitude matrices 

 4.3 compute global locations for all points 

 4.4 assemble position constraints 

 4.5 assemble Jacobian

 

 4.6 Newton-Raphson update 

 4.7 check convergence - repeat 4.1 through 4.7 if needed

5.0 Velocity solution

 5.1 assemble 

 5.2 compute  for 

6.0 Acceleration solution

 6.1 rip new values for  and  from 

 6.2 assemble 

 6.3 compute  for 

**Four Bar Example**

AB = 30 cm

BC = 60 cm

CD = 45 cm

AD = 90 cm

BG3 = 23 cm

DG4 = 24 cm

2 = 65°

3 = 13.151°

4 = - 65.173°

3

C

G3

13.151°

4

B

2

G4

2

A = G2

65.173°

D

65°

D

1

1

D4

C4

G4

G4

x4

y4

4

A2

B2

x2

y2

G2

2

B3

C3

G3

G3

x3

y3

3

blueprint information





adjust 

check 

driver 

adjust 

desire 

constraints 

Newton-Raphson position solution 

velocity solution 





acceleration solution 

****



need  and  from 









using blueprint information



evaluating terms



AB = 30 cm

BC = 60 cm

CD = 45 cm

AD = 90 cm

BG3 = 23 cm

DG4 = 24 cm

2 = 65°

3 = 13.151°

4 = - 65.173°

JAC = [ 1.0000 0 0 0 0 0 0 0 0 ;

 0 1.0000 0 0 0 0 0 0 0 ;

 1.0000 0 27.1890 1.0000 0 5.2330 0 0 0 ;

 0 -1.0000 -12.6780 0 1.0000 -22.3970 0 0 0 ;

 0 0 0 -1.0000 0 8.4180 1.0000 0 -19.0590 ;

 0 0 0 0 -1.0000 -36.0300 0 1.0000 -8.8817 ;

 0 0 0 0 0 0 1.0000 0 21.7820 ;

 0 0 0 0 0 0 0 1.0000 10.0770 ;

 0 0 1.0000 0 0 0 0 0 0 ];

det(JAC) = -2.6450e+03

transpose



from Notes\_06\_01 matrix static force analysis





shift origins to A, B and C

use BG2 = r2 BG3 = 0 CG3 = r3 CG4 = 0 DG4 = r4







r3 = BC = 60 cm r4 = CD = 45 cm 3 = 13.151° 4 = - 65.173° = -2.6441e+03

**Four bar**

E

3

 

C

A

B

4

2

D



**General slider crank**

A

B

C

C

Q

P

D

4

2

3

4

 

**In-line slider crank**



C

B

4

3

2

A

**Inverted slider crank**

 

A

B

D

C

2

3

4

B

Q

3

**Two link manipulator – joint interpolated motion**

A

B

2

3

C

 

**Two link manipulator – straight line interpolated motion**

 

A

B

2

3

C

