[1], [2],*[3]

[1] , [2] , [3]

Development of an equilibrium manipulator micro motion robot

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1.

,
(parallel manipulator)   . 1965
Stewart   stewart platform[1,2]   (platform)
(base)   6   (actuator)
.
(serial manipulator)

,

.   , stewart platform   6
(degree of freedom)   ,
(closed loop)

,

[3]   , stewart platform

.[4]

(forward kinematics)   (inverse
kinematics)   .[4]
stewart plat-
form

.

Newton-Raphson   .[5-7]
stewart platform $\pm 1 \mu m$
stewart platform   ,
,   . Fig. 1
stewart platform   .

Fig. 1 Developed stewart platform

2. Simulation and experiment

2.1 Design and simulation
stewart platform   PTC
Pro-ENGINEER   .
,

. Fig. 2   Pro-ENGINEER
. (a)   stewart platform
, (b)   X   , (c) Z   ,   (d)
X   .

2.2 Programming by using Visual C++
Visual C++
,
.
stewart platform   Visual C++

. Fig. 3
.
3   , Fig. 4   .
(a)   .
2   ,   global   6
.
link   6
.
Homing
Homing   .   All Homing   6
Homing   .
link jog movement   (b)   .
6   jog

.

.
global jog movement   (c)로 이 창   6
global   jog

.

.

2.3
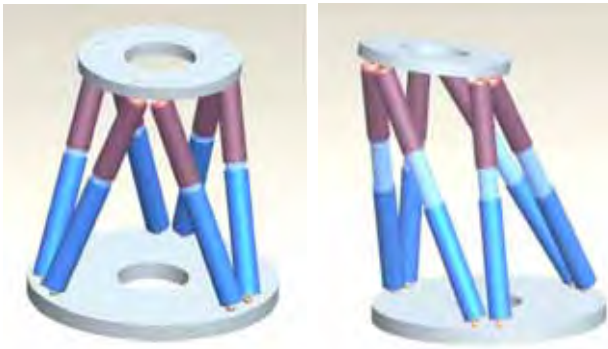Table 1   stewart platform   .

3.

$\pm 1 \mu m$
stewart platform
,   .
AutoCAD
Pro-ENGINEER   .   stewart platform
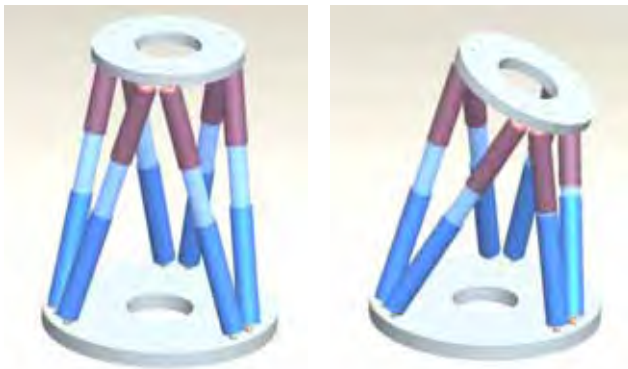Visual C++

.

(a) Original position　　　(b) Moves to X-axis

(c) Moves to Z-axis　　　(c) Rotates to X-axis
Fig. 2 Simulation by using Pro-ENGINEER

Fig. 3 Control panel by using Visual C++

(a) Real position panel

(b) Link jog movement panel

(c) Global jog movement panel
Fig. 4 Detailed control panel

Table 1 Technical data of developed stewart platform

사용 Motor	M230.25	Unit
Travel X,Y	±25	mm
Travel Z	±12.5	mm
Travel Θ_x, Θ_y	±7.5	deg
Travel Θ_z	±15	deg
Actuator Stroke	±12.5	mm
Min. Incremental Motion X,Y	1	μm
Min. Incremental Motion Z	0.5	μm
Min Incremental Motion $\Theta_x, \Theta_y, \Theta_z$	5	μrad
Repeatability X,Y	±2	μm
Repeatability Z	±1	μm
Repeatability $\Theta_x, \Theta_y, \Theta_z$	±10	μrad
Velocity X,Y,Z (typ.)	2.5	mm/sec
Velocity X,Y,Z (max.)	4	mm/sec
Velocity $\Theta_x, \Theta_y, \Theta_z$ (typ.)	25	mrad/sec
Velocity $\Theta_x, \Theta_y, \Theta_z$ (max.)	50	mrad/sec
Weight	13	Kg
Load capacity(vertical)	116	Kg
Load capacity(random)	10	Kg
Size ⌀D	280	mm
Size ⌀d	182	mm
Size H	300	mm

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