ICMTE 2014 Poster Template

Poster size : A1 (594 mm x 841 mm)
Title : Font size Bold 65

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Introduction (Font size 36)

◆ Workspace of planar 3-DOF parallel manipulator

- Parallel manipulator : High Precision, High Stiffness
  Light weight, Stable operation
  Limited Workspace
- Maximizing the workspace of a planar 3-DOF parallel manipulator on 100 x 100 mm² size
- Kinematics, Design Optimization, Control and Experiments

Position Kinematics

Schematic Diagram of 3-DOF parallel manipulator

$${}^{B}C_i = {}^{B}P_N + {}^{B}_{H}R\,{}^{H}C_i = {}^{B}A_i + \rho_i e^{\theta_i} + b_i e^{\gamma_i}, \quad i = 1,2,3$$

$$\rho_i = M_i \pm N_i$$

Where,

$$M_i = ({}^{B}x_{C_i} + {}^{B}x_{A_i})\cos\phi_i + ({}^{B}y_{C_i} - {}^{B}y_{A_i})\sin\phi_i$$

$$N_i = \sqrt{b_i^2 - S_i^2}$$

$$S_i = ({}^{B}x_{C_i} - {}^{B}x_{A_i})\sin\phi_i - ({}^{B}y_{C_i} - {}^{B}y_{A_i})\cos\phi_i$$

- B is fixed on base and H is moving platform
- Simulation by MATLAB™

Design Optimization

- *maximize* $f(x) = W$ *over* $x = [e \;\; r \;\; b]^T$

Subject to : $g_1 : 0 \le \rho_i \le \sqrt{3}r$

$g_1 : b + e = r/2$

$x_{lb} \le x \le x_{ub}$

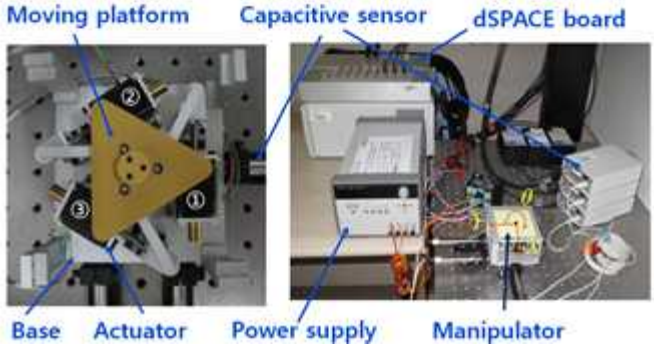
Design variable	e	r	b
x_{lb} [mm]	0	59	35
x_{ub} [mm]	10	61	45

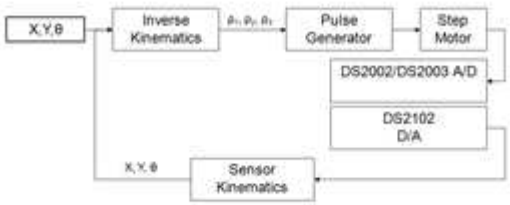
Bounds of the design variables

Objective	Design variable		
W (Workspace)	e [mm]	r [mm]	b [mm]
0.2608	9	59	41

Optimization results

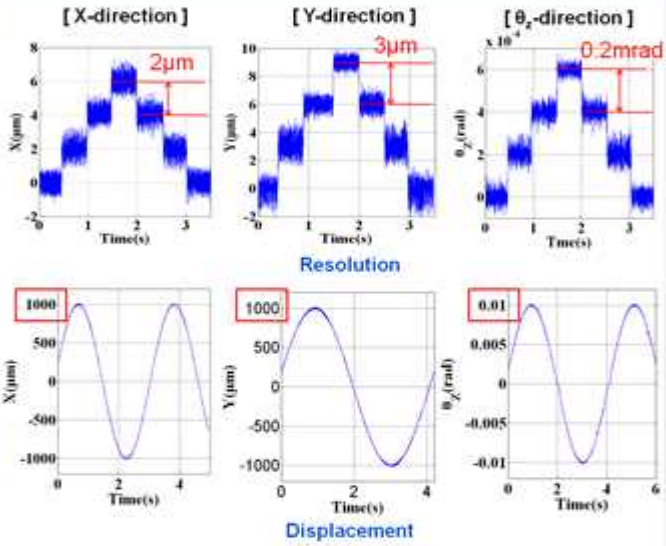
Experiments





Block Diagram for the Closed-loop Control

Experiment results



- Resolutions of X and Y axis translation are 2.3 μm
- Resolution of Z axis rotation is 0.2mrad (0.0115°)

Conclusion

◆ Design and Control of proposed 3-DOF manipulator

- The manipulator was designed with design optimization
- Inverse kinematics of the mechanism was verified through the closed-loop control
- Workspace verification should be carried out in the future

Acknowledgement

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REFERENCES

[1]Lee, C. W., Jang, S. C., 2010, A Fundamental Study on Offshore Structures of High Pressure Control Valves, Journal of KSMTE, 19:6 883-888,