

Poster size : A0 (841mm × 1189mm)

Title : (Font size Bold 65)

Author's Name : A-A Lee^{1,#}, B-B Lee², C-C Lee² (Font size 36)

¹ Department of Mechanical Engineering, 0000 University, Seoul, Korea

² Korea Institute of Machinery and Materials, Daejeon, Korea

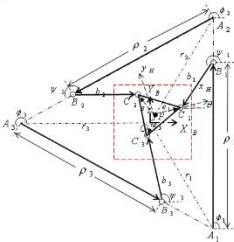
Corresponding Author / E-mail : 0000@icmte.kr

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

$${}^B C_i = {}^B P_H + {}^H R^H C_i = {}^B A_i + \rho_i e^{j\phi_i} + b_i e^{j\psi_i}, \quad i=1,2,3$$

$$\rho_i = M_i \pm N_i$$

Where,

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

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

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

Design Optimization

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

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

$$g_1 : b + e = r / 2$$

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

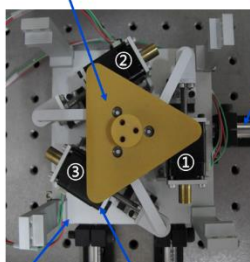
Design variable	e	r	b	Objective	Design variable		
x_{lb} [mm]	0	59	35	W (Workspace)	e [mm]	r [mm]	b [mm]
x_{ub} [mm]	10	61	45	0.2608	9	59	41

Bounds of the design variables

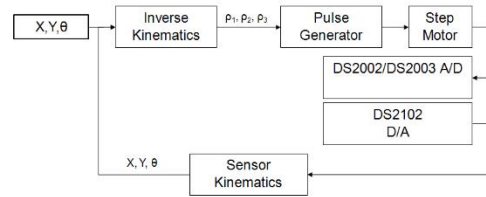
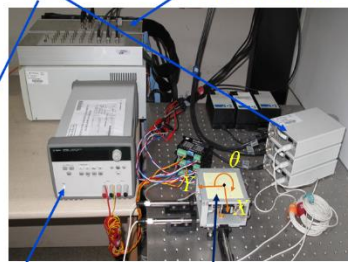
Optimization results

Experiments

Moving platform Capacitive sensor dSPACE board

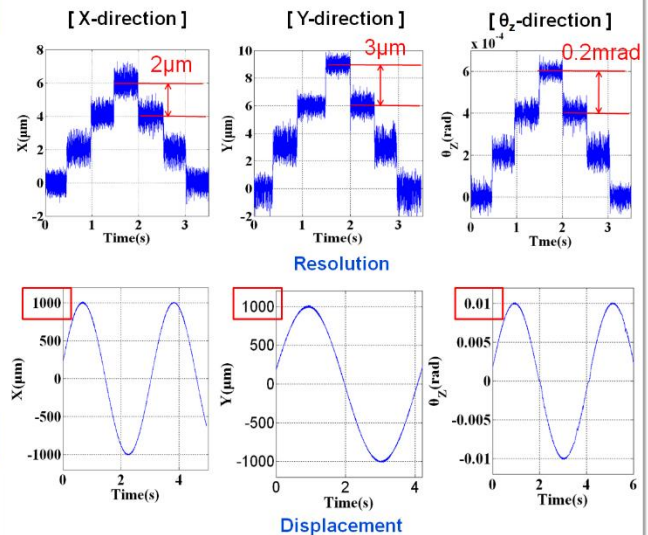


Base Actuator Power supply Manipulator



Block Diagram for the Closed-loop Control

Experiment results



Resolution

Displacement

- 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) C. M. Gosselin, S. Lemieux and J.-P. Merlet, 1996, "A new architecture of planar three-degree-of-freedom," Proceeding of Int. Conference on Robotics and Automation, Vol.4, pp. 3738~3743.