KONTAKT 2010

Planar Noncontact Manipulator Using Magnetic Levitation

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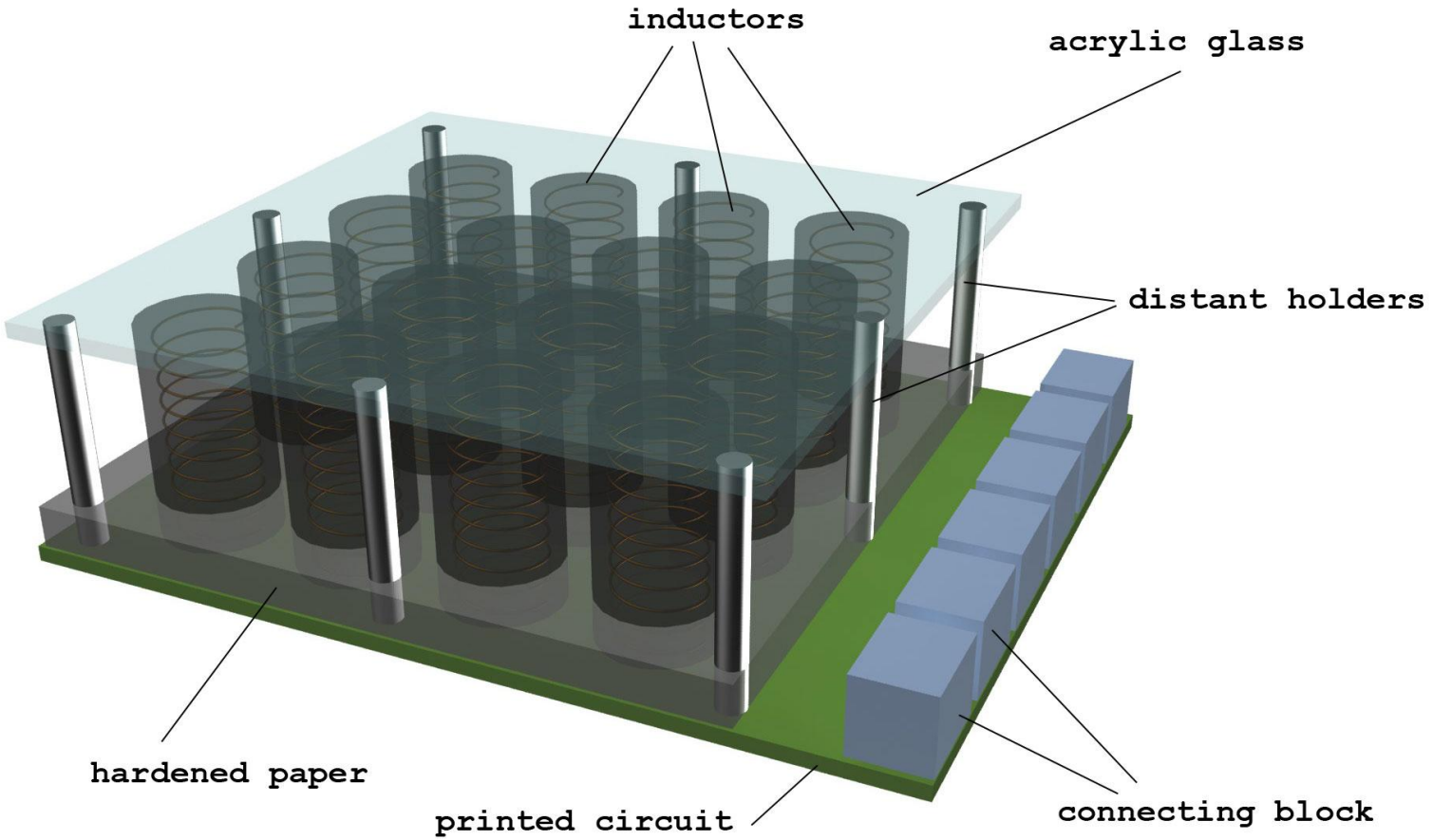
Planar Noncontact Manipulator Using Magnetic Levitation

- Sixteen electromagnets experimental platform



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- I have analyzed possibilities of planar control using array of coils
- I have developed software to simulate movement in general force field

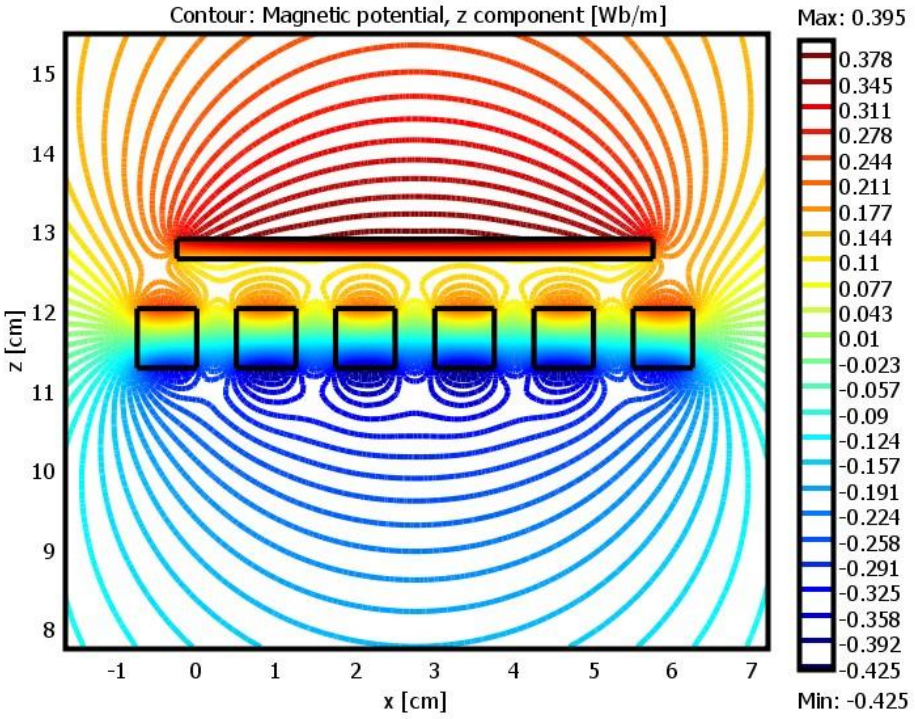

Fig. 2: FEM simulation of magnetic levitation

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- Comparison of simulated and real experiment of planar control movement

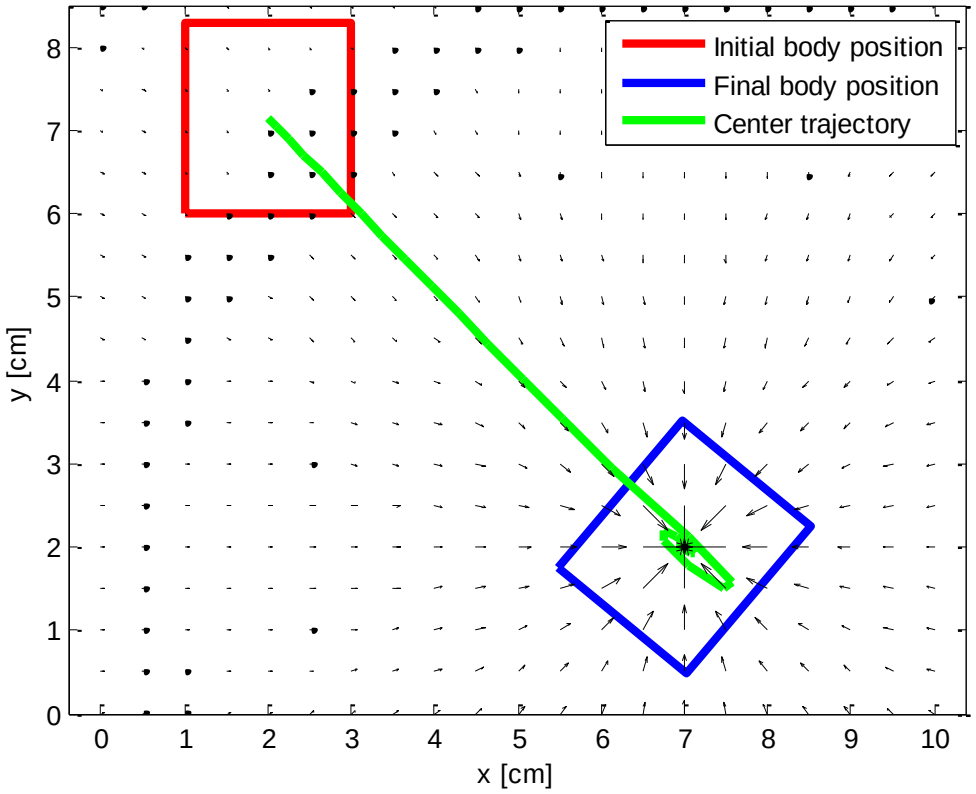

Fig. 3: Simulation

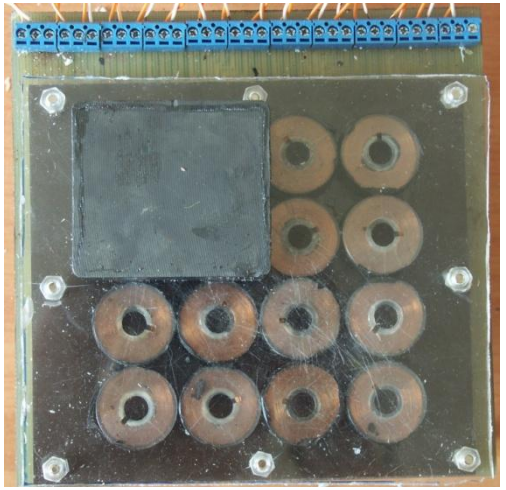

Fig. 4 a) : Experimet initial position

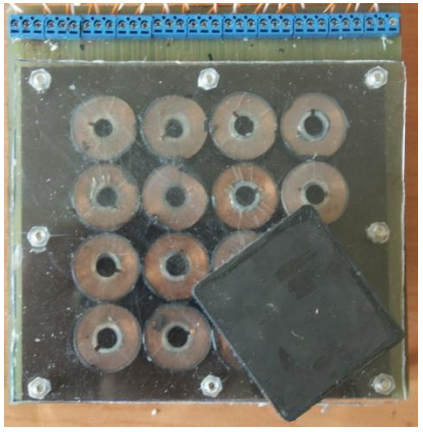

Fig. 4 b) : Experimet final position

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Feedback is necessary in order to achieve stable magnetic levitation. This physical law (Earnshaw's theorem) is apparent from figure 1.

The force density field acting on the body is defined by the following equation

$$\mathbf{f} = -\frac{\partial}{\partial t}\int_V (\mathbf{p}_i + \mathbf{g}_i)dV = \oint T_{i,j}\mathbf{n}_j ds \qquad (1)$$

I have developed an experimental platform of sixteen coils to study planar control possibilities. The interactive model is shown in figure 2.

The example of the planar control using an experimental platform is shown in figures 3 and 4. The figure 3 shows simulation of movement that is calculated using equation (1). The figure 4 shown a real experiment with the permanent magnet. Comparison of the figure 3 and 4 demonstrates that the simulation is quite accurate and well represents real behavior of the entity.

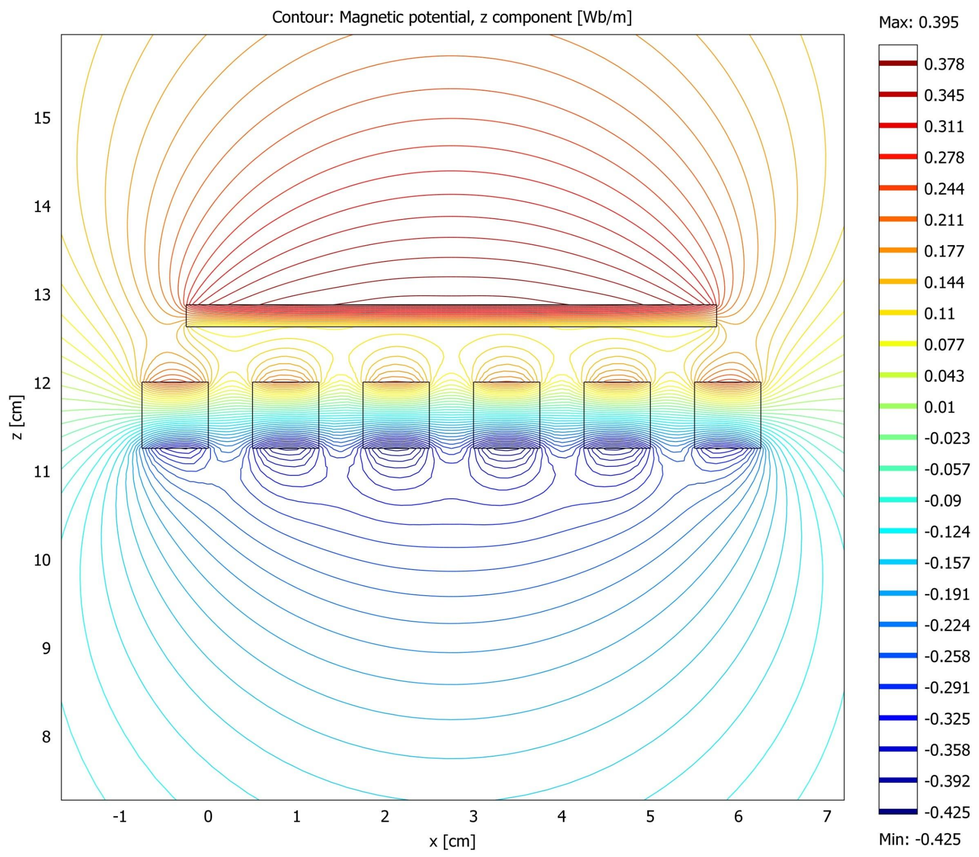


Fig.1: Magnetic potential between array of magnets and levitating magnet

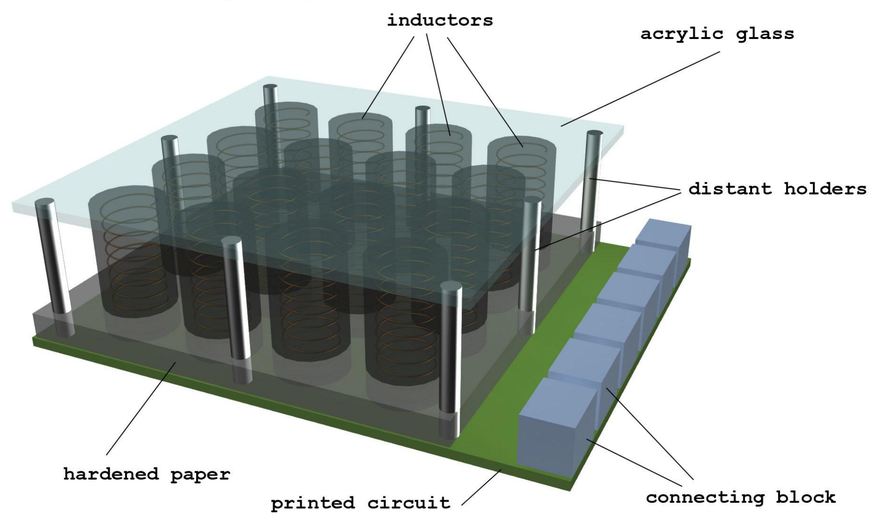


Fig. 2: The interactive model of experimental platform

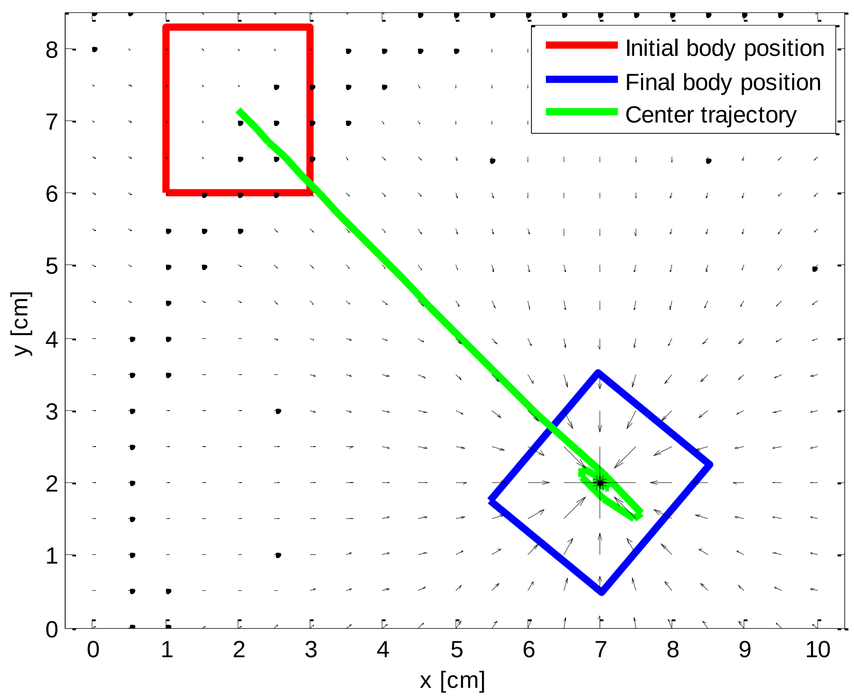
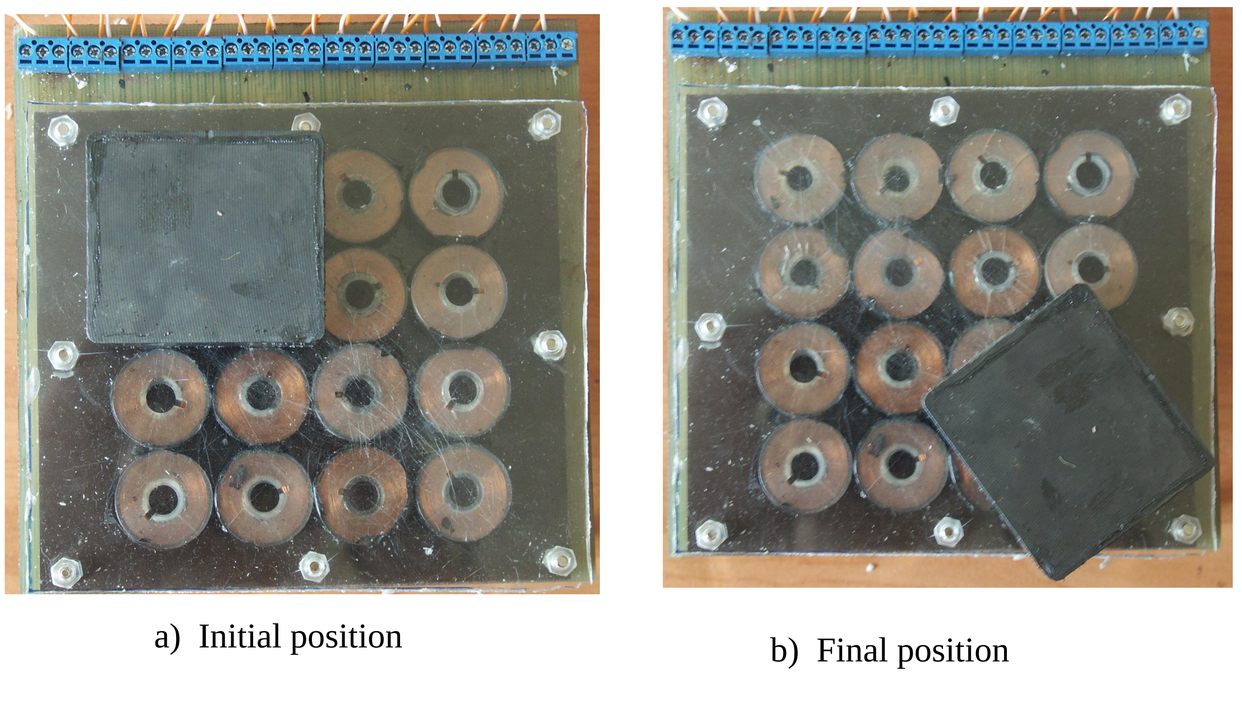


Fig. 3: Simulation of planar control



a) Initial position

b) Final position

Fig. 4: Planar control experiment