Open-Loop Centering of Parts on a Horizontally Vibrating Frictional Table

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Parts manipulation refers to the process of handling, orienting, and assembling mechanical or electronic components in industries such as manufacturing, robotics, and automation.

The simplest type of manipulation is parts feeding, which involves the automated movement of one or more objects to a target position. Prehensile and non-prehensile feeding techniques are two major categories used in automation. Prehensile techniques involve grasping or holding the part using robotic grippers, which are common in robotic arms and are used to pick and place objects precisely.

On the other hand, non-prehensile techniques do not involve direct grasping but rely on pushing, sliding, vibration, rolling, or controlled motion to guide parts to the desired location. Examples include vibratory bowl feeders, conveyor belts, air jets, etc.

Reznik [1] proposed using a flat rigid frictional table as a universal planar part manipulator. Time asymmetric vibrations are given to the table to ensure the continuous net frictional force is acting on the particles that are placed on the table.

However, closed-loop control was used for manipulation, with feedback of the part's position using a camera. Vose et al. [2] achieved open-loop control of parts on a vibrating table by exciting it in all six degrees of freedom using six actuators. In our work, we introduce a novel open-loop method to vibrate the table purely horizontally, causing parts placed on it to move toward the center due to friction.

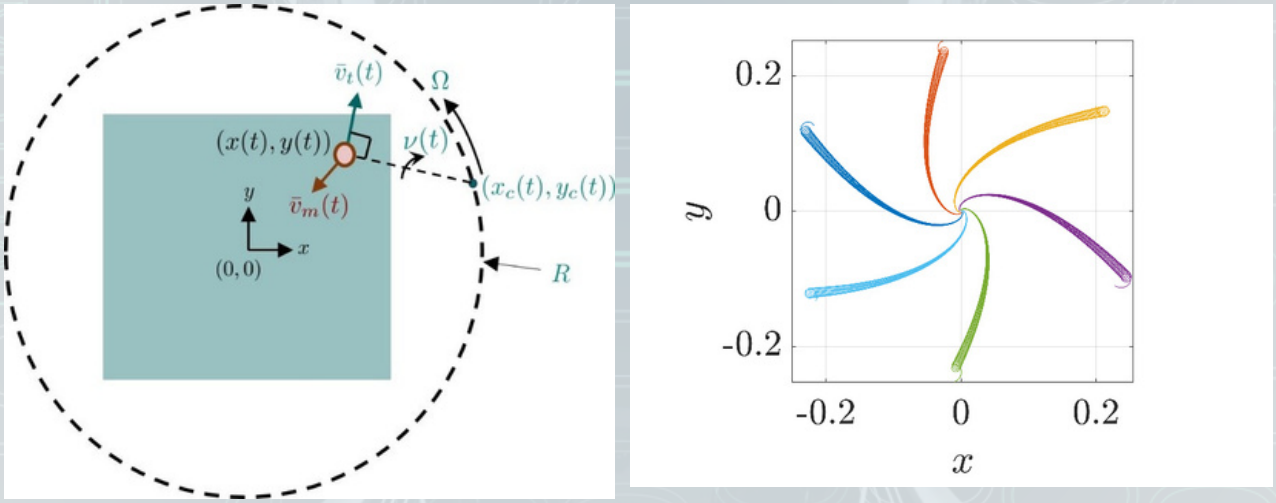

Figure 1 (a). Schematic representation of the horizontally vibrating table and the particle. The table moves in the x–y plane. It rotates about its instantaneous centre with angular velocity. The sliding particle is instantaneously at the point in space. The velocity of the sliding particle is, and the velocity of the physical point of the table instantaneously touching the particle is given by. (b) Trajectories of the particle in the x–y plane for different initial conditions show the approach to the target location (the origin).

References

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