

## Six-Degrees-of-Freedom Mini Motion Platform

### 1. Background

The Stewart-Gough platform is a six-degrees-of-freedom (DOF) motion platform pertaining to the category of parallel robotic manipulators. It has six linear actuators (known as limbs or legs) connecting a top mobile platform with a bottom fixed platform. Fixed platform is typically connected to the legs by six universal joints, and the mobile platform on which the end-effector is mounted, is connected to the legs through six spherical joints. The motion of the end-effector is controlled by changing the lengths of the legs in various proportions. This job is done through the linear actuators, which may be of hydraulic piston-cylinder type or electrical motor with precision ball-screw type.



Figure 1 Mini Motion platform at PAR lab IIT Delhi

In the six-DOF motion platform developed at the PAR (Programme for Autonomous Robotics) Lab. of IIT Delhi, as shown in Fig. 1, the actuators are electrically driven. They are used to train airplane pilots, drivers of cars, heavy vehicles, etc. and high precision surgery.

### 2. Scope

The mini motion platform shown in Fig. 1 can be used as a ‘plug-n-play’ educational device for academic/research activities and high school community. Commercially available platforms are large in general, expensive and occupy a lot of space. They also consume a lot of electric power due to large motors. They are dangerous due to large masses and inertias. The platform shown in Fig. 1 is very suitable for research and experimentation purposes, and for the beginners who want to get acquainted with robotics. An instructor/teacher can even carry it to the classroom (net weight only 5 kg) for demonstration to the students.

### **3. Specifications**

Type: 6 DOF, Parallel Stewart Platform

Number of axes: 6

Weight: 5 kg

Payload: 2 kg @6V

Maximum displacements: X~10mm, Y~10mm, Z~90mm

Angular displacements: Roll~23°, Pitch~23°, Yaw~23°

Material Coupler and bolts: Stainless steel

Actuators: Engineering plastic body

Top and bottom platform: Mild steel/acrylic

Maximum velocity: 20 mm/s approx.

Operating voltage: 7.5V

Maximum current: 3A at full load

Power supply: 220V@50Hz

Actuator characteristics Feedback: Position Actuonix L12-I 50mm-50:1-6 vdc with an embedded internal position controller that allows sending position commands which the actuator will follow. It can accept voltage, current or RC signal inputs.

It can be disassembled easily for transport; Off-the-shelf components used; Low cost Assembly instructions, user documentation, example python codes for ptp-motion control will be provided.

### **4. Demonstration capabilities**

It can be used to demonstrate forward and inverse kinematics in a typical robotics course; singularities; point-to-point (PTP) motion.