

CE152

Magnetic Levitation Apparatus

Shows students how to control a non-linear, unstable system (a steel ball in a magnetic field)



- Compact, benchtop apparatus, ideal for classroom demonstrations and student projects
- Uses a magnetic field to control the vertical position of a steel ball
- Shows the dynamics of a one-dimensional, non-linear, unstable system
- Supports investigations into a number of different control algorithms based on classical and modern control theory – includes PID, LQ/LQC, adaptive, fuzzy and non-linear controller design and operation
- Hardware module is supplied fully assembled and includes integral power supplies
- System accessible directly from MATLAB®/Simulink® environment in real time
- Includes comprehensive Educational Manual

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Magnetic Levitation Apparatus

Description

The Magnetic Levitation Apparatus shows control problems with non-linear, unstable systems.

The apparatus consists of a steel ball held in a magnetic field produced by a current-carrying coil.

At equilibrium, the downward force on the ball due to gravity (its weight) is balanced by the upward magnetic force of attraction of the ball towards the coil. Any imbalance and the ball will move away from the set-point position.

The basic control task is to control the vertical position of the freely levitating ball in the magnetic field of the coil.

The Magnetic Levitation Apparatus is a non-linear, dynamic system with one input (coil current) and one output (ball position).

A sensor measures the position of the ball. A power amplifier with overheat protection drives the coil.

The equipment includes:

- The ball and coil
- A power supply/interface
- A data acquisition board for your computer

The data acquisition board fits into a suitable computer (not included) to link with the interface and control the coil, and accept the signal input from the sensor.

Software (included):

- Demonstration program with PID controllers
- Interface library for programming at the system level
- Example Simulink® models for real-time control experiments

Essential Ancillaries

(Not supplied by TecQuipment)

- Suitable computer with a spare PCIe (PCI Express) slot and Microsoft® Windows® XP, Vista, 7 or 8 operating system. 32-bit and 64-bit.

Note: If you have an older computer with only PCI slots, please contact our sales department.

- Software:
 - MATLAB®
 - Simulink®
 - Real Time Windows® Target
 - Simulink Coder® (recommended)
 - Simulink 3D Animation (recommended)

Standard Features

- Supplied with comprehensive user guide and educational manual
- Five-year warranty
- Made in accordance with the latest European Union directives

Experiments

The Educational Manual contains a structured series of experiments that guide the user from system modelling and identification to full non-linear control.

Experiments include:

- Real time digital signal processing
- Digital PID controller design for ball position stabilisation and trajectory tracking
- LQ/LQG controller design based on state and I/O model
- Fuzzy controller design
- Adaptive controller design
- Non-linear controller design

Essential Services

Electrical supply:

110/220 VAC, 50 W, 50/60 Hz, with earth
Specify at time of order

Bench space needed:

500 mm x 800 mm

Operating Conditions

Operating environment:

Laboratory

Storage temperature range:

–25°C to +55°C (when packed for transport)

Operating temperature range:

+5°C to +40°C

Operating relative humidity range:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

Sound Levels

Less than 70 dB(A)

Specifications

Dimensions and weight:

Magnetic levitation model: 200 x 250 x 175 mm; 2 kg
Power supply: 165 x 140 x 65 mm; 1.5 kg.

Data Acquisition Board:

PCIe x1

Approximate packed dimensions and weight:

0.06 m³ and 6 kg

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