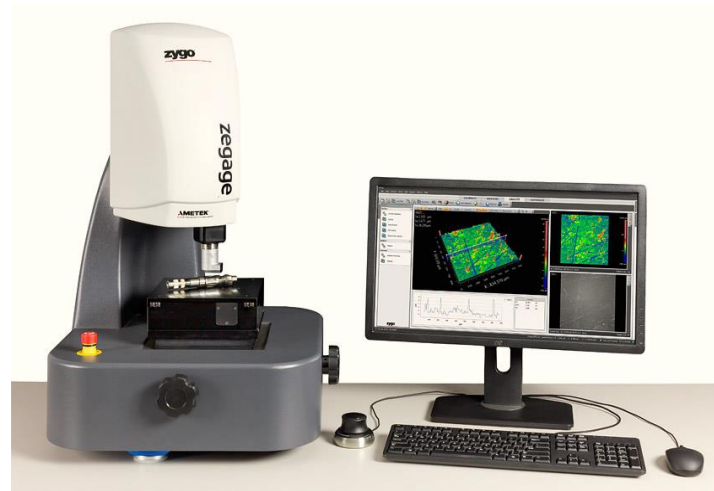


3D measurements; Coordinate Measuring Machine (CMM)



Dr. Amandeep Singh
Department of Mechanical Engineering
Indian Institute of Technology, Kanpur

Contents

- ✓ 3D Measurements
- ✓ Co-ordinate Measuring Machine (CMM)
- ✓ Universal CMM Controller (UCC)
- ✓ Laboratory demonstration on using CMM

3D Measurements

Virtual representation of a physical object

3D Scanners → 3D Scans (output)

How it works?

1. Point cloud (Acquisition of Scan)

2. Triangle Mesh (Mesh generation)



3. Optimize mesh

4. Mesh output (alignment or registration)

5. Mesh input to the engineers (.stl)

[CAD modelling]

1. CMM

2. Tracked 3D Scanner

3. Structured light Scanner

4. Portable 3D Scanner

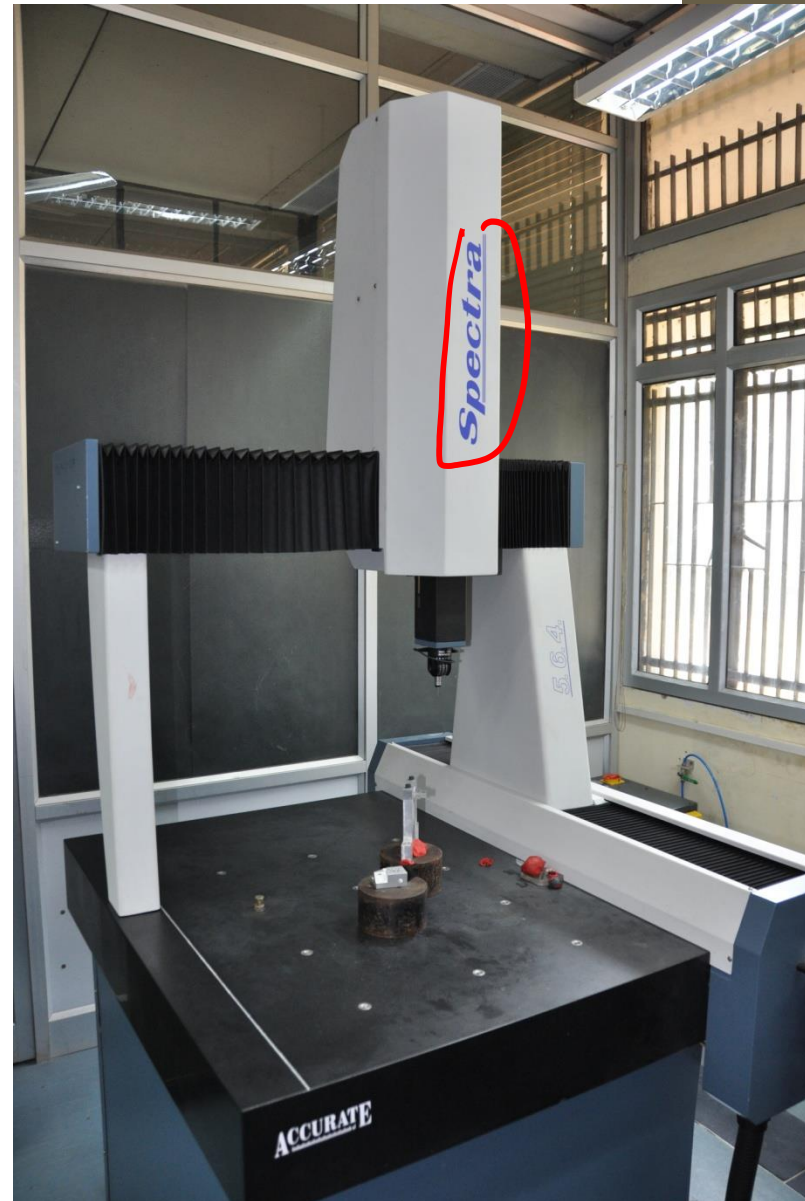
Reverse Engineering.

Coordinate-measuring machine

- A coordinate measuring machine is a device for measuring the physical geometrical characteristics of an object.
- This machine may be manually controlled by an operator or it may be computer controlled.
- Measurements are defined by a probe attached to the third moving axis of this machine.
- Probes may be mechanical, optical, laser, or white light, amongst others.
- A machine which takes readings in six degrees of freedom and displays these readings in mathematical form is known as a CMM.

Objectives

- Familiarize yourself with parts of a CMM.
- Understand the principle and the working of a CMM



Coordinate-measuring machine

- Coordinate-measuring machines include three main components.

1. The main structure which include three axes of motion. x, y, z

2. Probing system.

3. Data collection and reduction system - typically includes a machine controller, desktop computer and application software.

UCC

Revision

Working principle of CMM

- A coordinate measuring machine is also a device used in manufacturing and assembly processes to test a part or assembly against the design intent.
- By precisely recording the X, Y, and Z coordinates of the target, points are generated which can then be analyzed via regression algorithms for the construction of features.
- These points are collected by using a probe that is positioned manually by an operator or automatically via Direct Computer Control .

Main parts of CMM

- ✓ • Air Bearing
- ✓ • Scales and Encoders
- ✓ • Probing system
- ✓ • Servo motors
- ✓ • Control system
- ✓ • Joystick
- ✓ • Software (Tangram)

Advantages of CMM

- ✓ Flexibility *Manual or Automated*

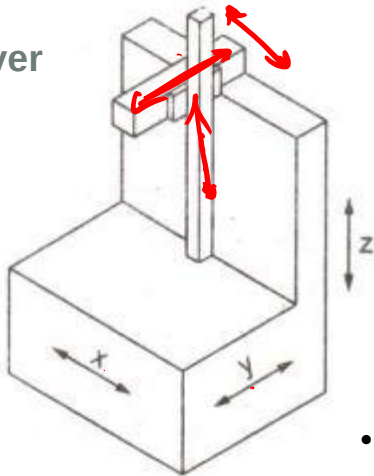
- Reduced Setup Time
- Single Setup
- Accuracy
- Reduced Operator Influence
- Improved Productivity ✓

Configuration of CMM

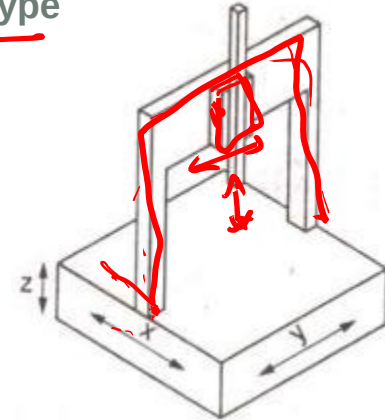
- Model: - Spectra 5.6.4. CNC
- Scale Regulation = 0.5 μm
- Machine accuracy = $(\pm 2.5 + L/250) \mu\text{m}$; (L: Standard length in mm)
- Angular accuracy = 1" (One second)
- Granite flatness = 2 micron per meter square
- Granite grade = zero grade
- Probing system = MS2DI
- M/c version = CNC version
- M/c working volume = X = 500 mm; Y = 600 mm; Z = 400 mm
- Controller name = Renishaw UCC (Universal CMM Controller) lite-2
(U.K.) /

Types of Main Structure arrangement

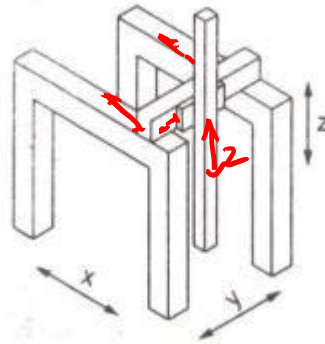
• Cantilever



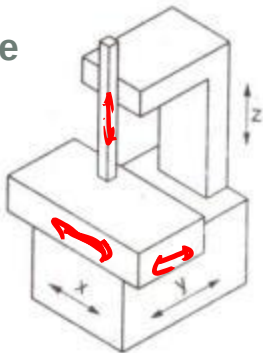
• Bridge Type



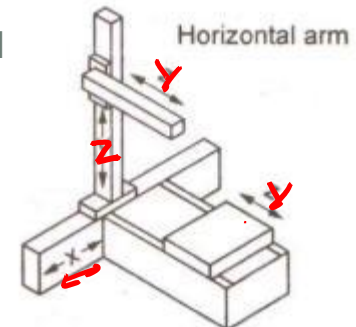
• Gantry



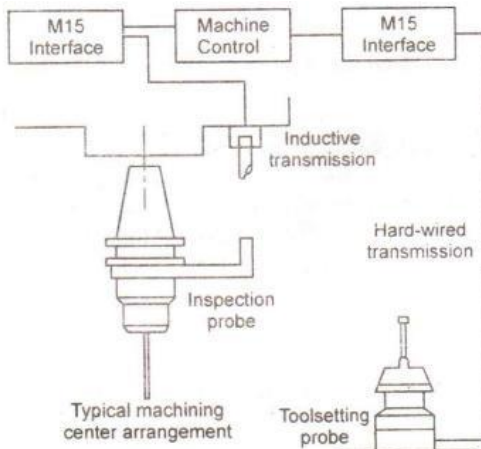
• Column Type



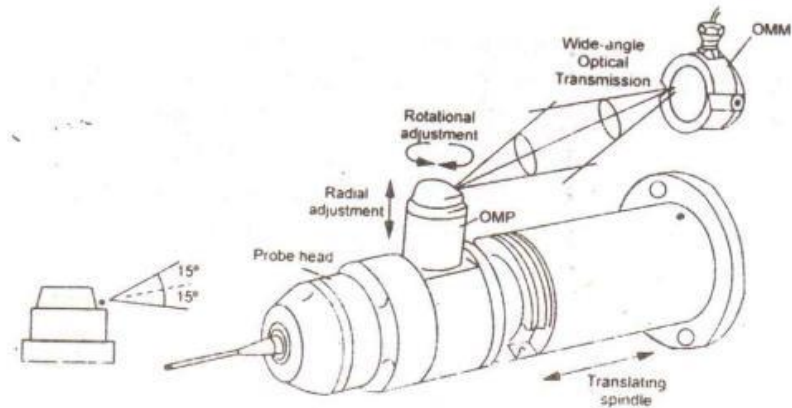
• Horizontal



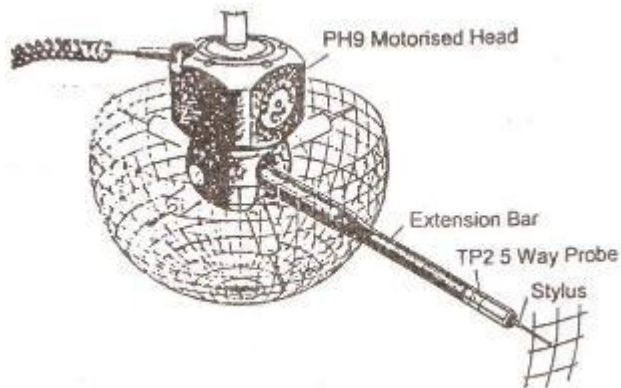
Types of Probing System



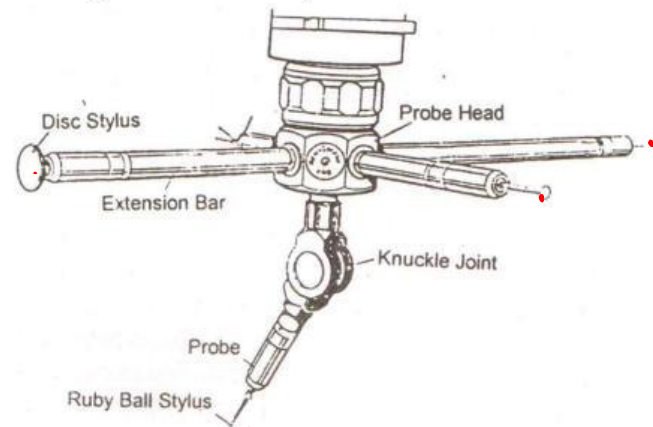
1. Inductive Probes



2. Optical Transmission Probes



3. Motorized Probes



4. Multiple Styluses Probes

Application of CMM

1. ☒ Aerospace Engineering
2. ☒ Automobile Engineering
3. ☒ Reverse Engineering
3. ☒ Medical Technology

Thanks