

Chapter 3 Overall Design of M&C Instr.

Lecture 3: Operating Principle Selection and System Design

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Outline

- ❑ Review: Measuring System
- ❑ Signal Transformation and Transmission Principles
- ❑ Standards and Subdivision Methods
 - ✍ **Classification and function**
 - ✍ **Standards for dimensional metrology**
 - ✍ **Standards' subdivision**
- ❑ Data Processing and Display Devices
 - ✍ **Function, type, and selecting method**
- ❑ Motion Mode and Control Mode



Concept of M & C: Measuring Systems

❑ Functions of Measuring Systems

Toy

Deaf
&
Blind
Or
Slow
!!

Signal Transformation and Transmission Principles

❑ Functions of Sensing

 **Position detection**

 **Value detection**

❑ Sensing methods

 **Contact**

 **Non-contact**

 **Embedded sensors**

❑ Transformation and amplification Principles



Signal Transformation and Transmission Principles

❑ Transformation and amplification principles

-  **Mechanical**
-  **Optical**
-  **Optoelectronic**
-  **Electrical**
-  **Pneumatic**



Standards and Subdivision Methods: Outline

- ❑ Classification and function
- ❑ Standards for dimensional metrology
- ❑ Standard subdivision



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Standards and Subdivision Methods

- ❑ Classification and function

- ❑ Functions

 -  **Measurement (Absolute)**

 -  **Master scales of Universal Tool Microscope**

 -  **Calibration (Relative) and Check instruments**

 -  **Dial indicators and Gage blocks**

- ❑ Single-Value and Multi-Value Standards

- ❑ Absolute and Incremental Standards



Standards and Subdivision Methods

❑ Standards for dimensional metrology

- ✍ Reference standards for length measurement
- ✍ Reference standards for angle measurement
- ✍ Complex reference standards



Standards and Subdivision Methods

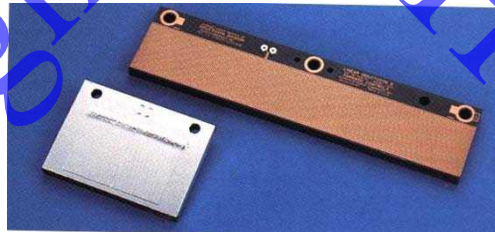
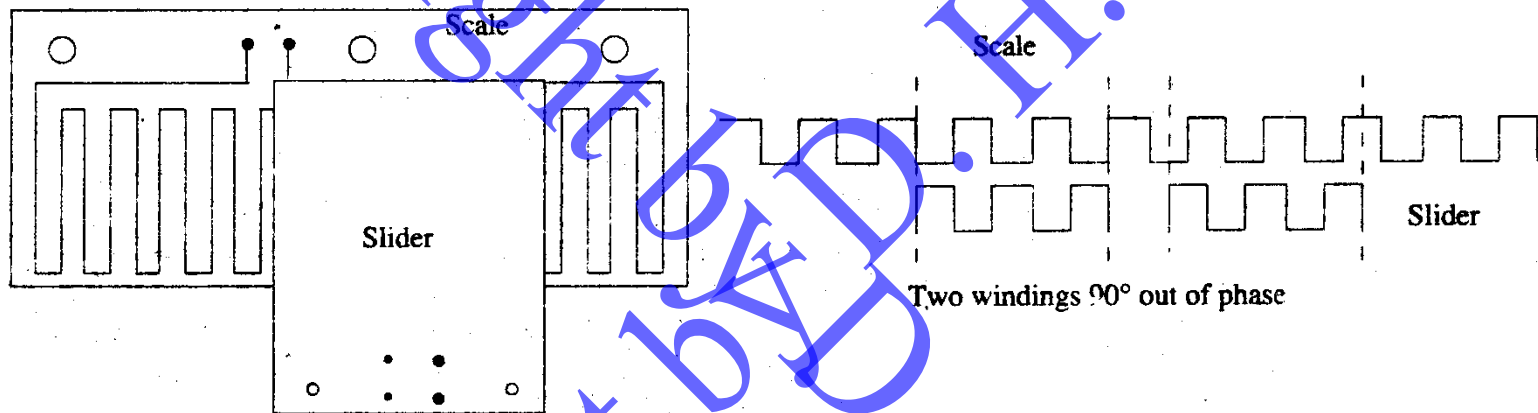
❑ Reference standards for length measurement

- ✍ **Gage Blocks**
- ✍ **Line Graduated Scales**
- ✍ **Precision screws**
- ✍ **Gratings**
- ✍ **Linear Inductosyn Transducers**
- ✍ **Linear capacitive sensors**
- ✍ **Magneto Linear Scales**
- ✍ **Absolute Position Encoders**
- ✍ **Interferometric Sensors**



Linear Inductosyn Transducers

□ Operating Principle



Linear Inductosyn Transducers

- ❑ Operating principle

- ❑ Key Benefits

- ✍ High linear accuracy: ± 40 microinches (± 0.001 mm)
- ✍ Can be mounted to form continuous measuring systems of unlimited length
- ✍ Can withstand conditions ranging from cryogenic temperatures and hard vacuum to high temperatures and pressures.
- ✍ Non-contacting elements have zero wear- No adjustment or lubrication ever required.

Linear Inductosyn Transducers

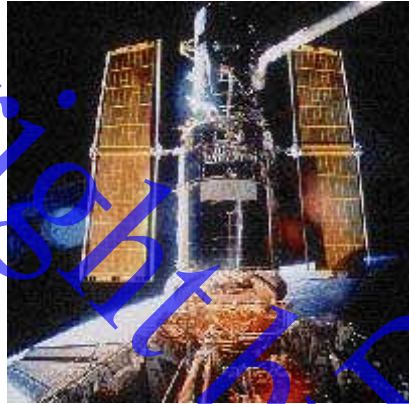
□ Applications

 **Automation & Scientific Applications**

 **Military & Aerospace**

 **Currently, Inductosyn® transducer applications include space satellites, submarine navigation systems, antenna pedestals, tracking mounts, telescopes, factory automation, robotics, machine tool control, cryogenic chambers, and hard vacuum chambers.**

Linear Inductosyn Transducers



- ☐ Submarine navigation systems
- ☐ Hubble Telescope
- ☐ Machine tool control
- ☐ Radar antenna



Linear Capacitive Sensors

❑ Sensors and the systems



Standard Subdivision

□ 光学机械细分法

✍ 直读法

✍ 微动对零细分

✍ 读数指标移动式

✍ 主标尺刻线象移动式

✍ 光学倍程法

□ 电气细分法

陈林才, 张鄂, 精密仪器设计。北京: 机械工业出版社, 1991

Standard Subdivision

□ 光学机械细分法

✍ 直读法

✍ 微动对零细分

✍ 读数指标移动式

✍ 主标尺刻线象移动式

— 转动平板玻璃

— 移动光楔

— 移动补偿透镜

✍ 倍程法

陈林才, 张鄂, 精密仪器设计。北京: 机械工业出版社, 1991

Standard Subdivision

□ 电气细分法

- ✍ 非调制信号细分法 – 光栅, 激光
- ✍ 调制信号细分法 – 感应同步器, 磁栅
- ✍ 相位细分法 – 光栅



Data Processing and Display Devices



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Data Processors: Functions

- ❑ Data processing
- ❑ Extend the range of instruments
- ❑ Increase the precision of instruments
- ❑ Automatization of the measuring process



Data Processors: Types

- ❑ Analog processors

- ❑ Digital processors

 - ✍ Single chip processor

 - ✍ DSP

 - ✍ PC

 - ✍ Giant computer



Display Devices: Types

- ❑ Indicative display devices
- ❑ Recorder
- ❑ Digital display devices
- ❑ Printable display devices

 **Ink-jet printer**

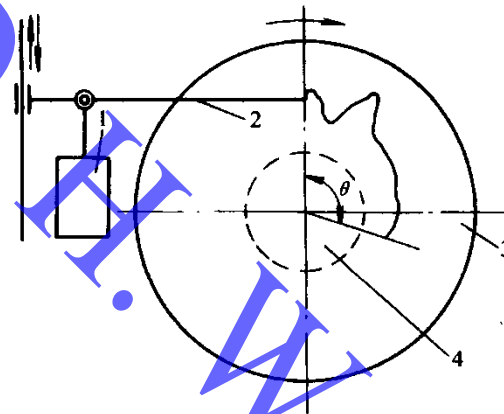
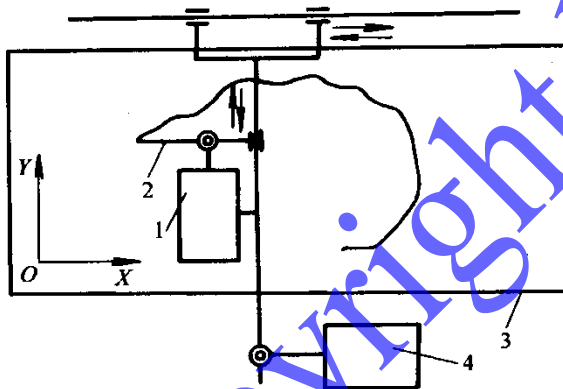
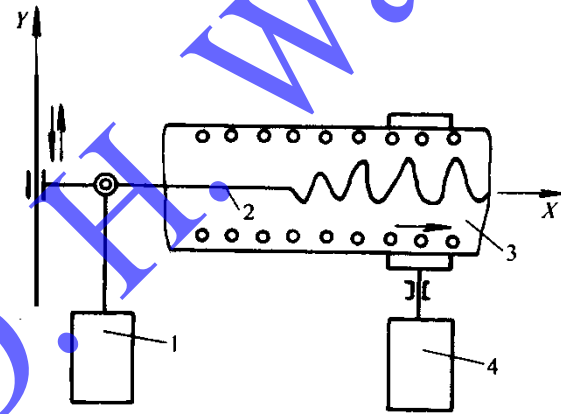
 **Laser-jet printer**

- ❑ Other display devices



Display Devices: Recorders

- ❑ Linear recorder
- ❑ X-Y recorder
- ❑ Circular recorder



Display Devices: Digital

☐ LED

☐ LCD

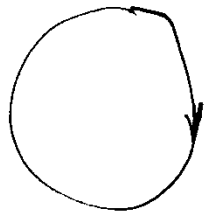
☐ CRT



Motion Modes and Control Modes

□ Basic motion mode and its combination

→ Linear motion (slideway)



circular motion (spindle)

→ + ↑ + ↘ ⇒ 3D motion (CMM)

→ + ↻ ⇒ Helix motion (screw)



The End

***Thank you very much for
your attention !***

