On-Machine Verification using Universal Platform

Narin Chanthawong, Ph.D.
CMM & Gear Laboratory
Dimensional Metrology Department
NIMT

"I AM NIMT"

Production process

- Production process sequence

Design
- Computer-aided drafting (CAD)
- Computer-aided manufacturing (CAM)

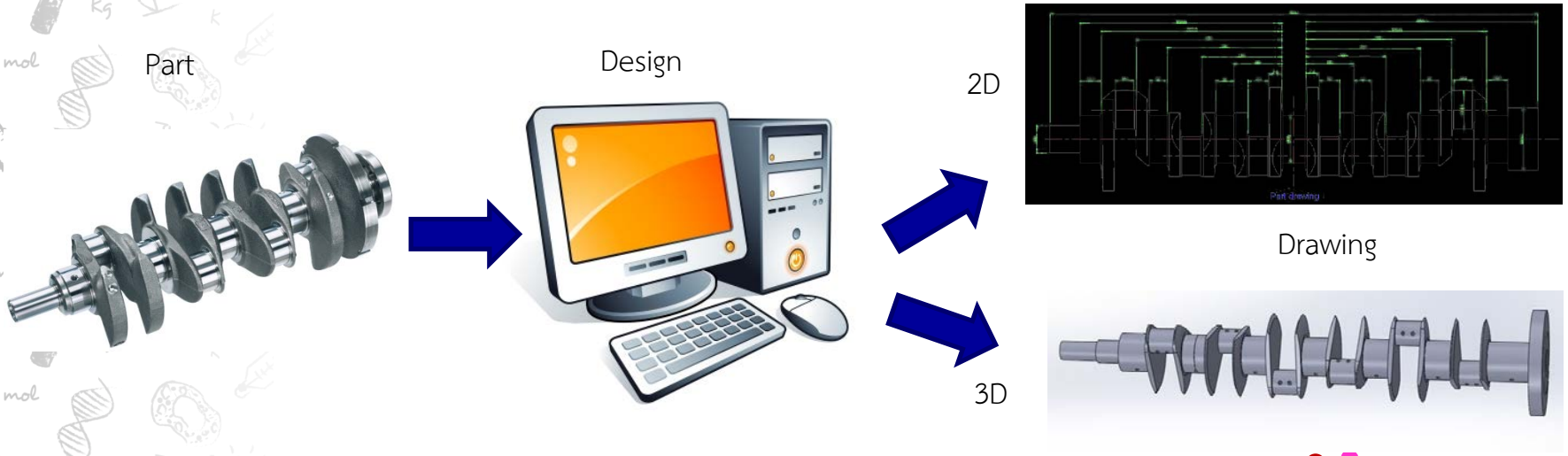
Manufacture
- Machining
- Casting
- Forging

Inspection
- Basic Measuring Instruments
- Advanced Measuring Instruments

"I AM NIMT"

Design

- Computer-aided drafting (CAD)
  - the use of computer systems to aid in the creation, modification, analysis, or optimization of a design.



https://en.wikipedia.org/wiki/Computer-aided_design

Manufacture

- Machine Tools
  - a machine for shaping or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing, or other forms of deformation.

Milling

Lathe

Wire-Cut

Inspection

- Measuring instrument
  - a device for measuring a physical quantity. Measurement is process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity.

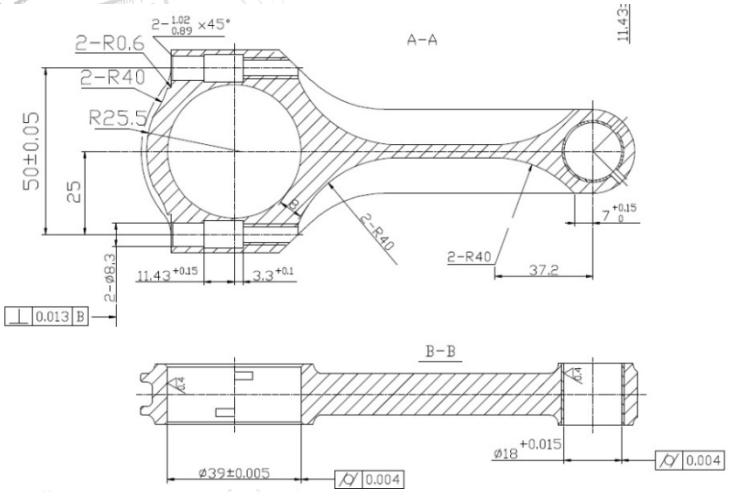
Basic Measuring Instruments

Advanced Measuring Instruments

"I AM NIMT"

Part Inspection

- Design VS Real part



Inspection

- Basic Dimension
- GD&T
- Etc.

If a real part does not comply with the design. It needs to rework.

"I AM NIMT"

Rework process

- Problem

Rework

NG

Drawing

ok

Parts

Light

Heavy?

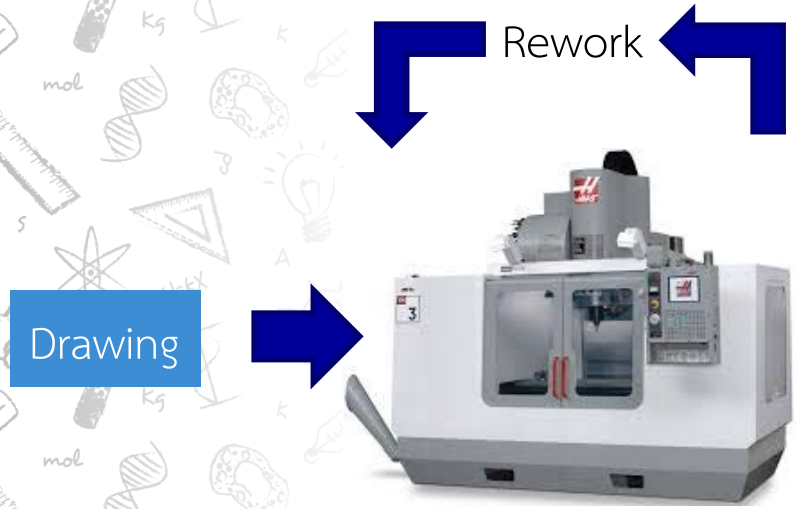
Parts size

- Handling time
- Re-alignment time

"I AM NIMT"

On-Machine Verification

- On-Machine Verification (OMV)
  - the system allows checking of machined parts without transferring them to CMM machines for inspection.



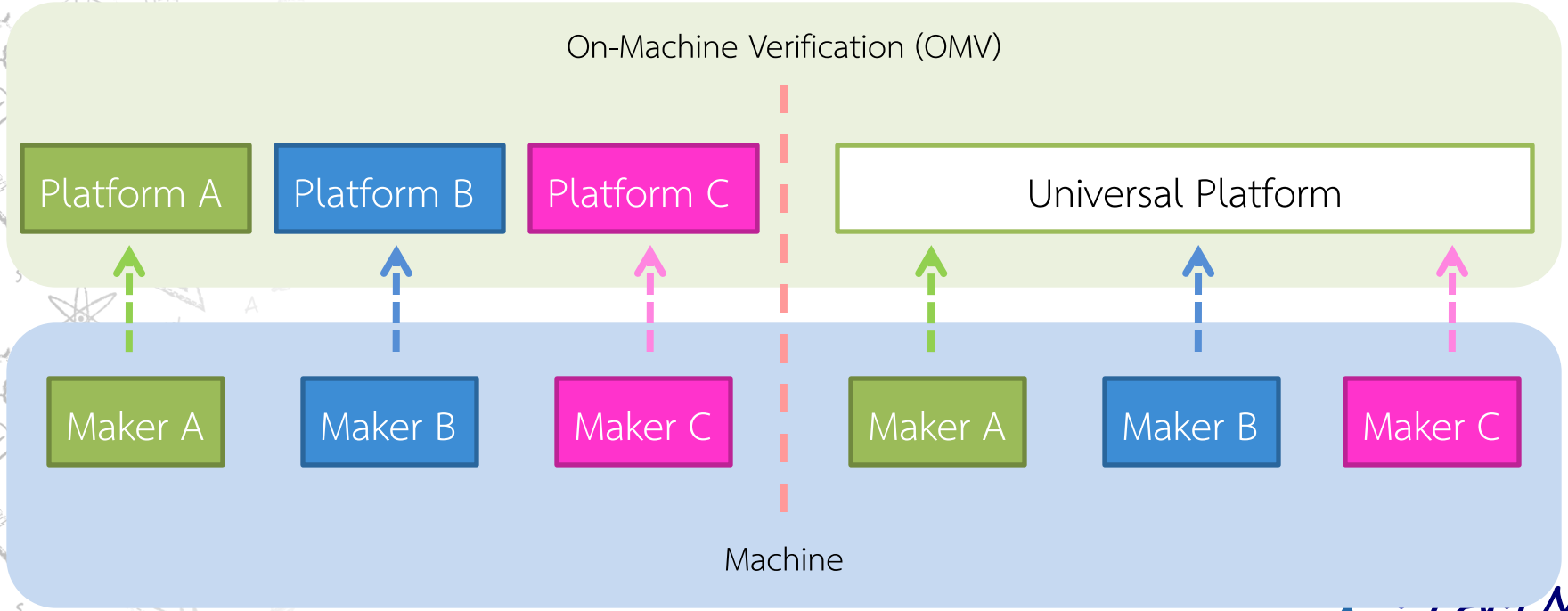
Exist, but

- Maker dependent
- High cost
- Un-support GD&T

"I AM NIMT"

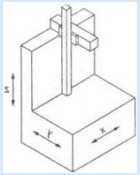
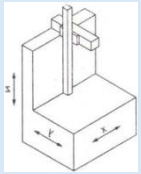
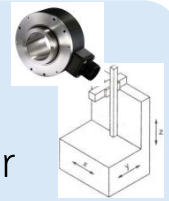
Universal Platform

- Universal Platform
  - Measurement platform that independent from maker.



Needs for OMV

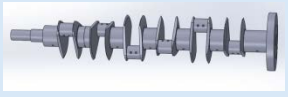
- System requirement

	Machine	Maker's OMV	Universal OMV
Tools	 cutting	Measurement Probe 	Measurement Probe 
Scale	 Internal Scale	 Internal Scale	Internal Scale/ External encoder 
Error	 Controller	 Controller	External 

Universal OMV

- OMV requirements
  - Low cost
  - Machine independent
  - Support CAD file
  - Enable for error compensation

Probe



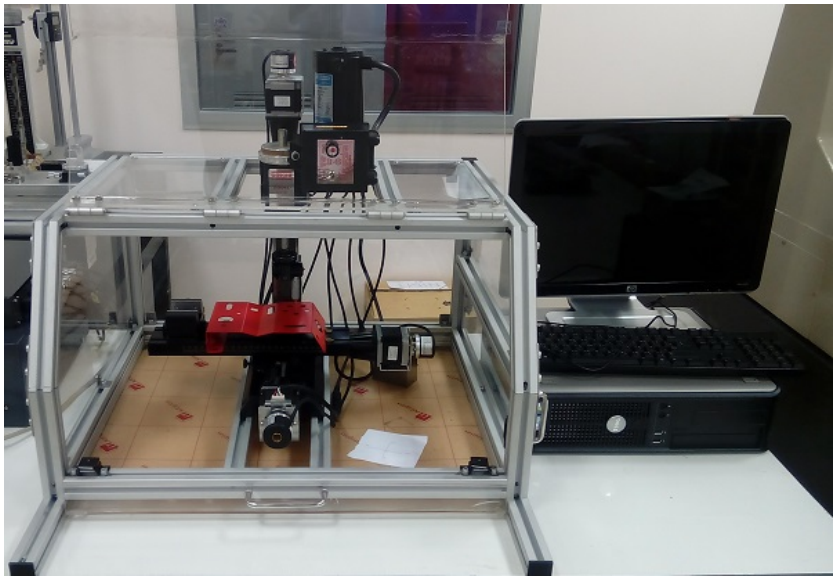
CAD file

Error Compensation

"I AM NIMT"

Prototype Machine

- Mini CNC Milling
  - Brand: Sherline
  - Model: 5410
  - Size: 230x230x200 mm
  - Software: Mach3



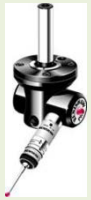
Sherline 5410

"I AM NIMT"

Prototype Machine

- OMV on Mini CNC

Renishaw PH1



Tools

External Encoder

Scale

PolyWorks

Polyworks Inspector

Software

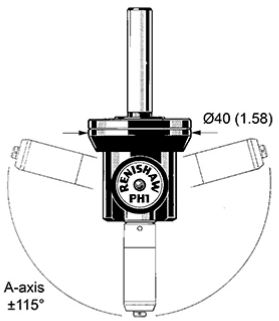
Laser Interferometer

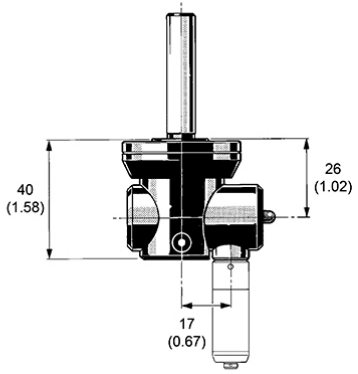
Laser Tracker

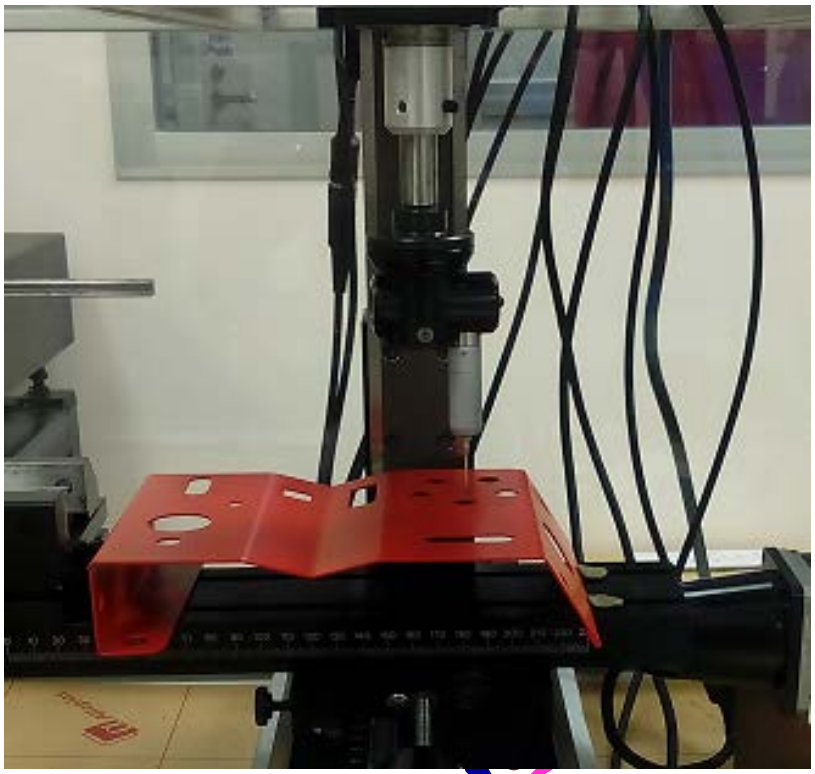
Error

Prototype Machine

- Renishaw PH1
  - Low cost
  - Mechanical probe
  - Easy wiring



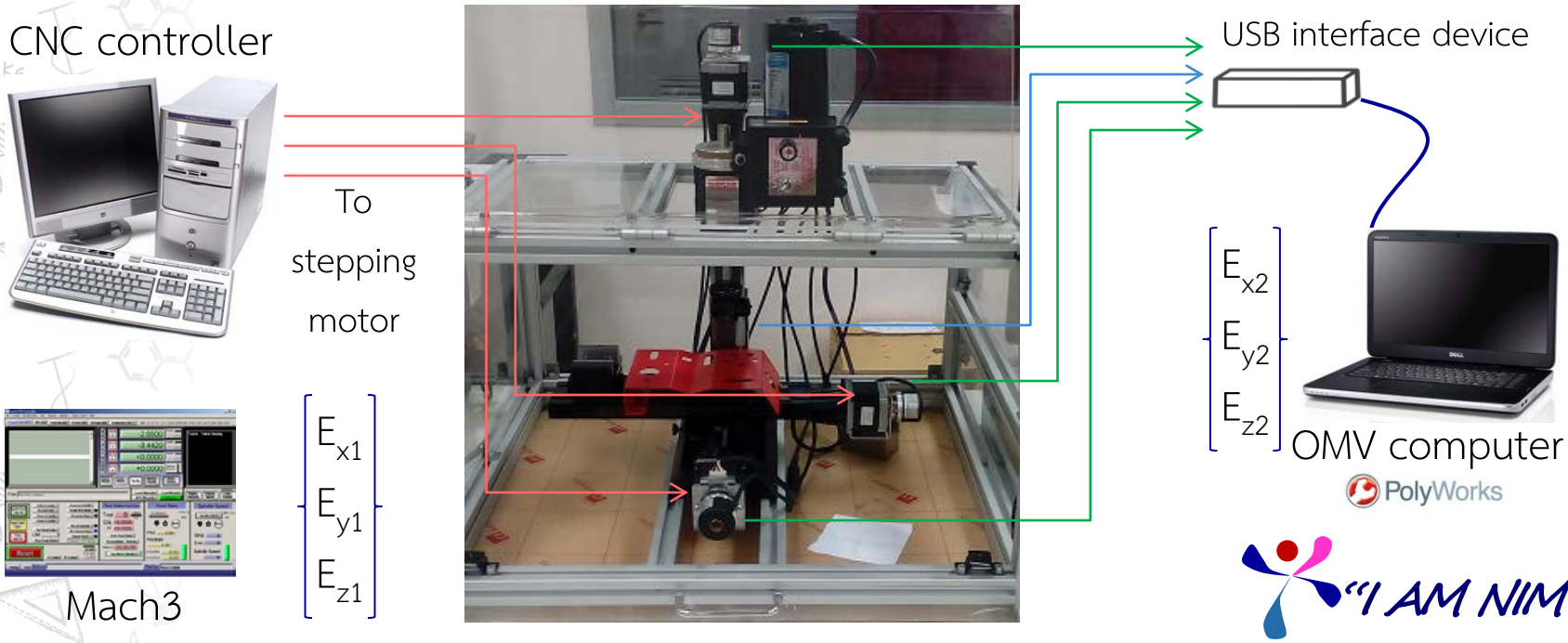




"I AM NIMT"

Prototype Machine

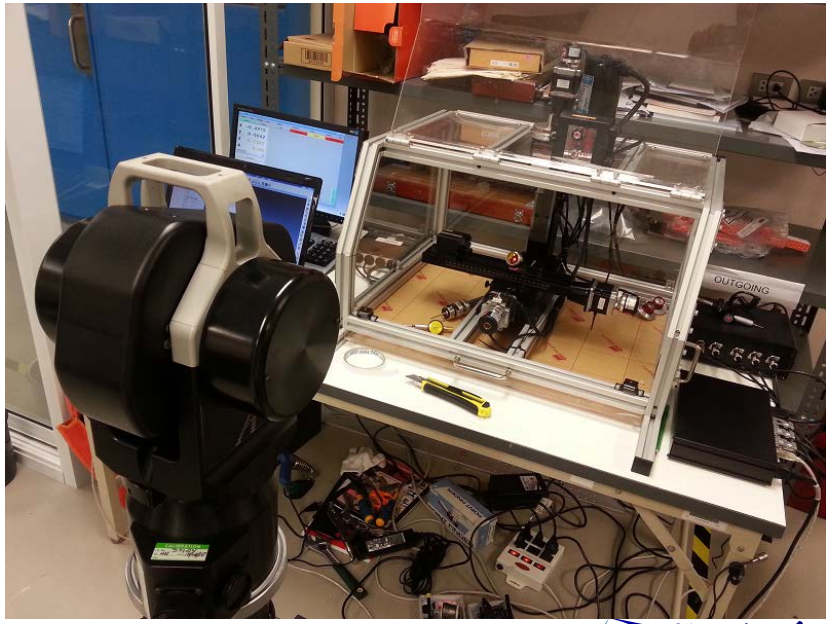
- Machine setup
  - The OMV is setup on Sherline 5410.



"I AM NIMT"

Prototype Machine

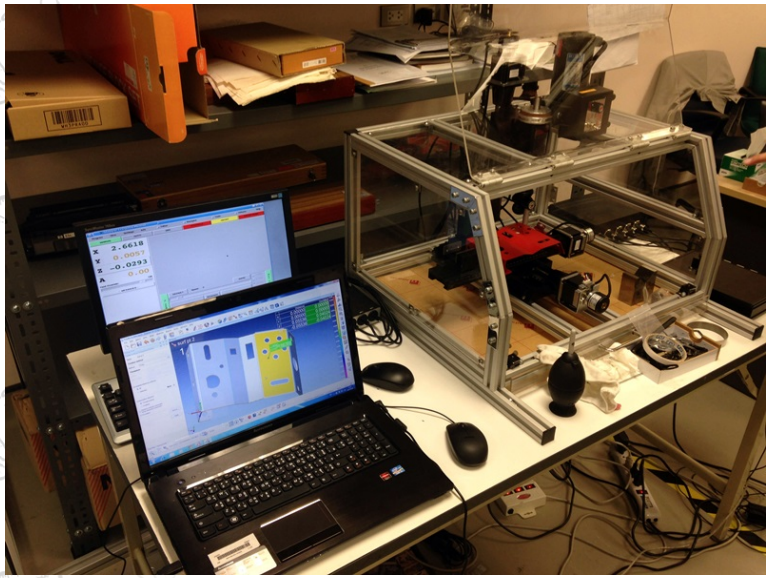
- OMV verification
  - A laser interferometer or a laser tracker can be used to verify the system accuracy.

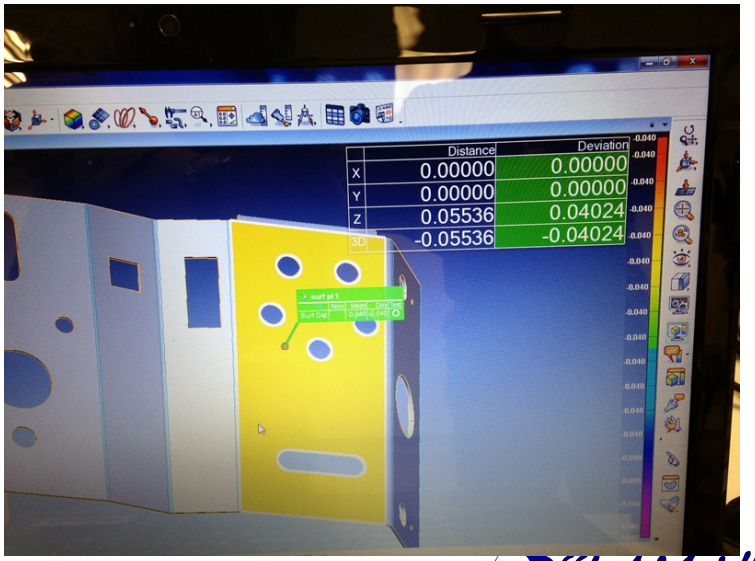


"I AM NIMT"

Prototype Machine

- OMV on Mini CNC
  - The OMV system works precisely on machine with accuracy of 4 μm.

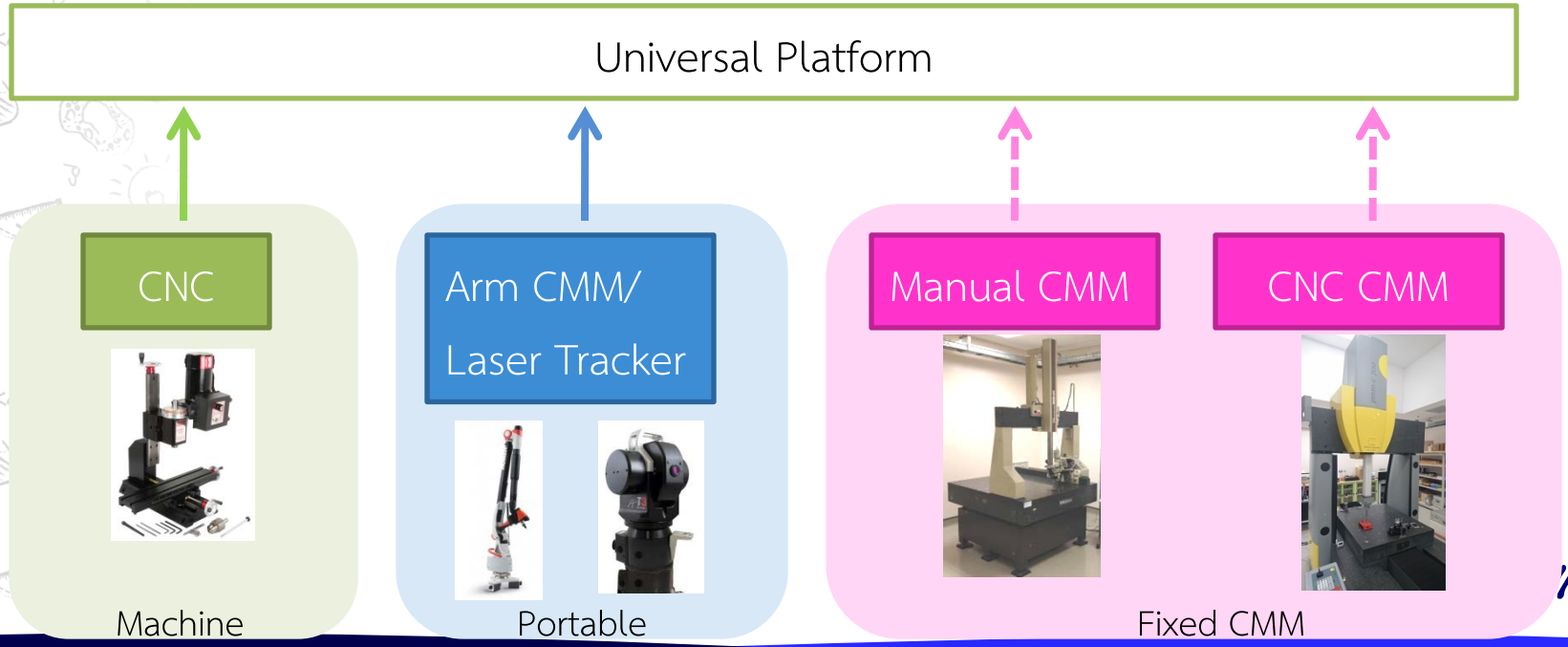




"I AM NIMT"

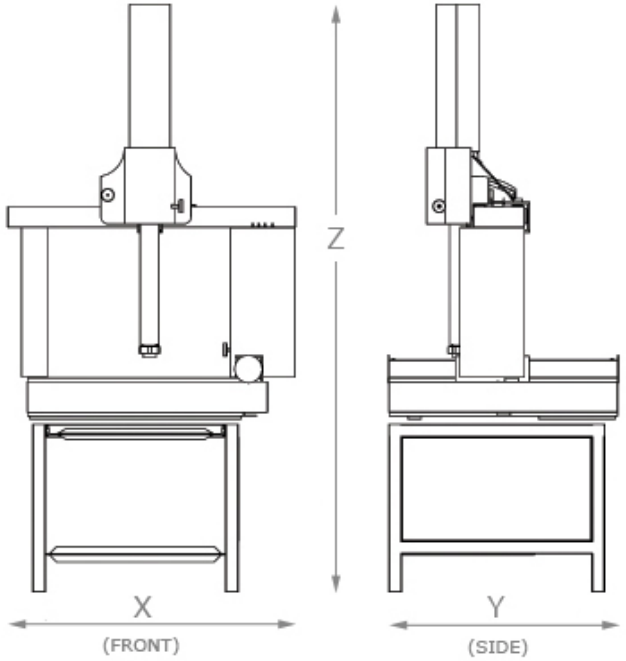
Platform extension

- Platform extension
  - The concept of universal platform can be extended to advanced measuring instruments.



Manual CMM

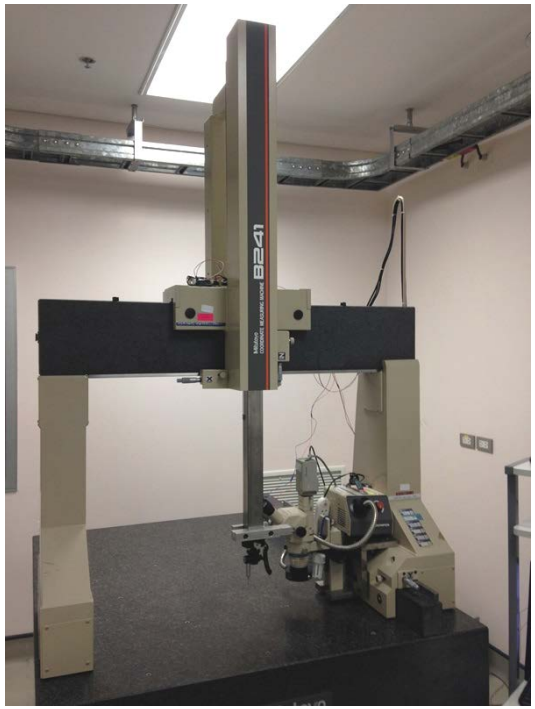
- Obsolete manual CMM
  - An obsolete manual CMM mostly work with basic commands which unsupported CAD file.
  - No temperature compensation.
  - Higher accuracy than Portable Instruments (Artificial ARM CMM, Laser Tracker).



"I AM NIMT"

Manual CMM

- Prototype manual CMM
  - Brand: Mitutoyo
  - Model: B-241
  - Size: 700x1000x600 mm
  - Year: 1987
  - Software: Micropeak 210

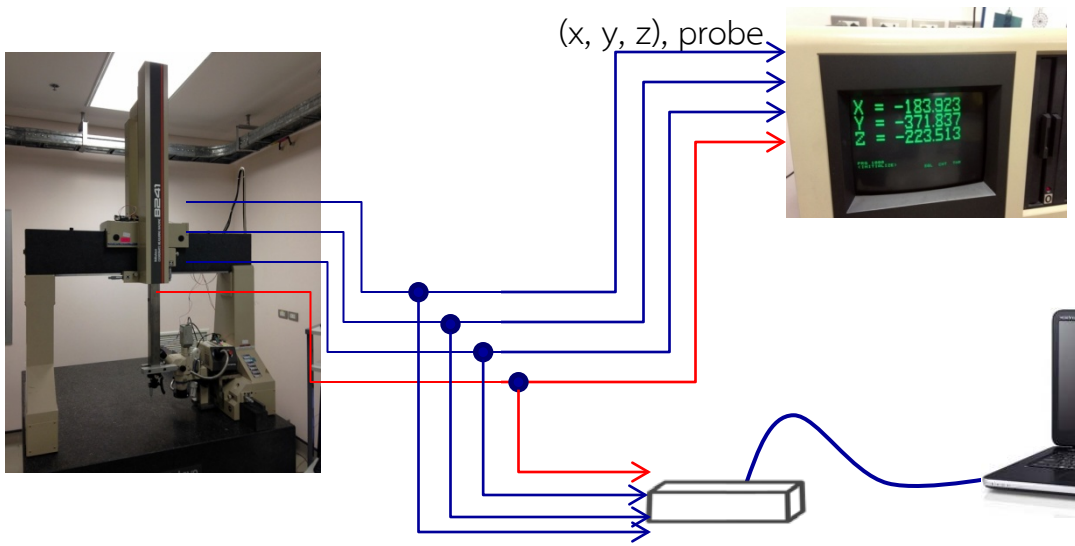


Mitutoyo B-241

"I AM NIMT"

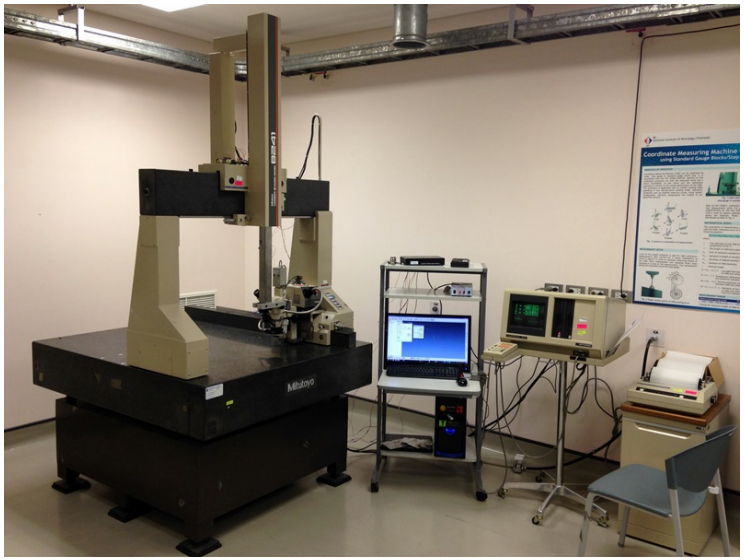
Manual CMM

- Cable connection
  - the signals of CMM are split into two parts seeding to an old controller and a usb interface device.



Manual CMM

- Improved obsolete manual CMM with universal platform
  - Maintain manual machine accuracy
  - Support CAD file
  - Temperature compensation



"I AM NIMT"

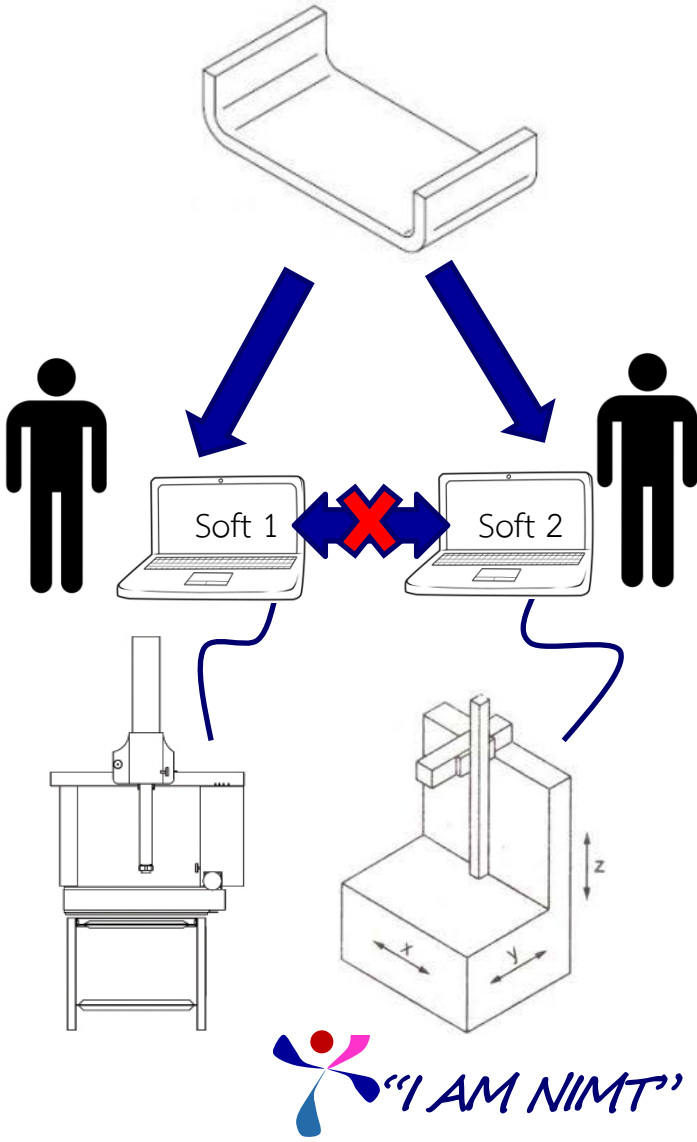
CNC CMM

- CNC CMM
  - High accuracy and high speed in measurement (< 3 μm).
  - Support CAD file
  - Require a specific code on each CMM platform.

"I AM NIMT"

CNC CMM

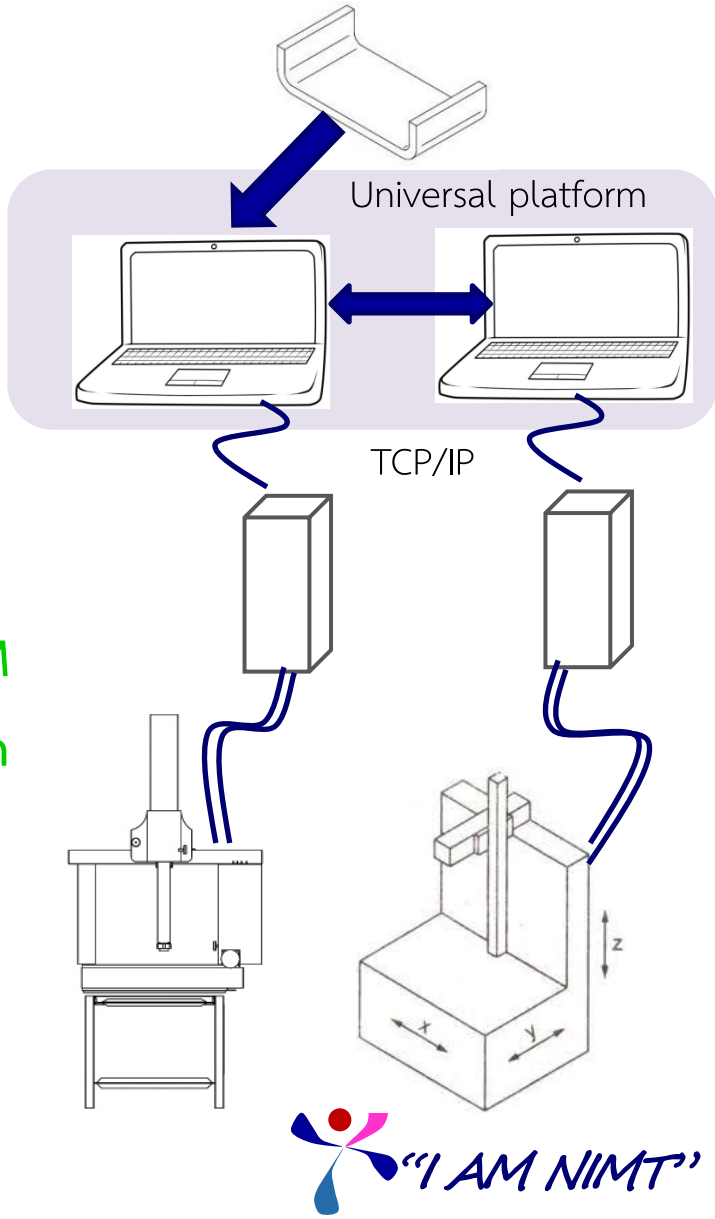
- CNC CMM
  - High accuracy and high speed in measurement (< 3 μm).
  - Support CAD file
  - Require a specific code on each CMM platform.



"I AM NIMT"

CNC CMM

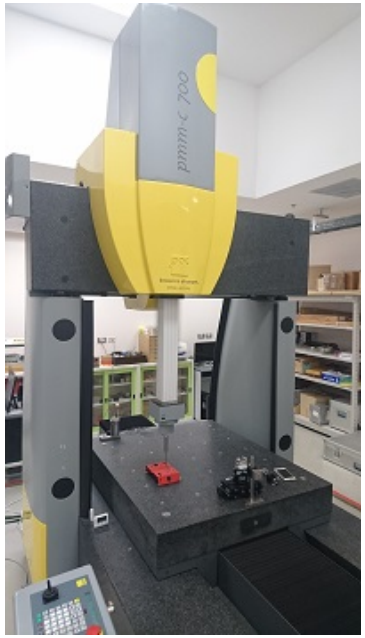
- CNC CMM with universal platform
  - CNC CMM connection via TCP/IP.
  - Enable for automatic measurement.
  - Capable of operating on various CMM machines with a single code, which reduce errors from user.

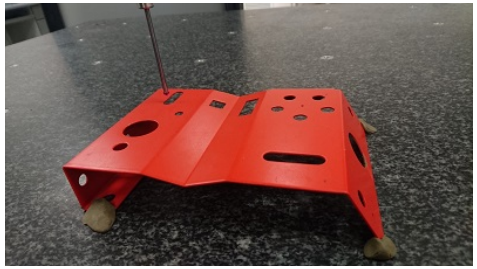


"I AM NIMT"

CNC CMM

- Prototype CNC CMM
  - Maker: Brown&Sharpe (Leitz)
  - Model: PMM-C700P
  - Volume: 1200 x 1000 x 700 mm
  - Accuracy: 0.6 μm + L/600
  - Software: Quindos 6





"I AM NIMT"

Conclusions

- The On-Machine Verification (OMV) is a useful technique to reduce time in production process. It can apply to various machine such as milling machine, Lathe Machine, wire-cut machine, etc.
- OMV technique decrease time-consuming processes, i.e. transportation between CNC machines and CMM and re-alignment on machines, especially for large-size part.
- The universal platform is versatile. It can be applied to CNC machine, manual CMM and CNC CMM.

"I AM NIMT"

Thank you for your attention

"I AM NIMT"