Investigation on uncertainty measurement of CT

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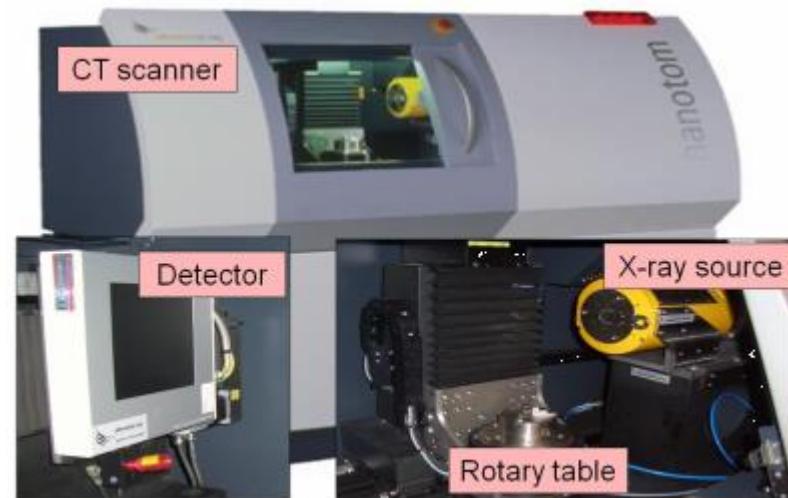4. Plan for future
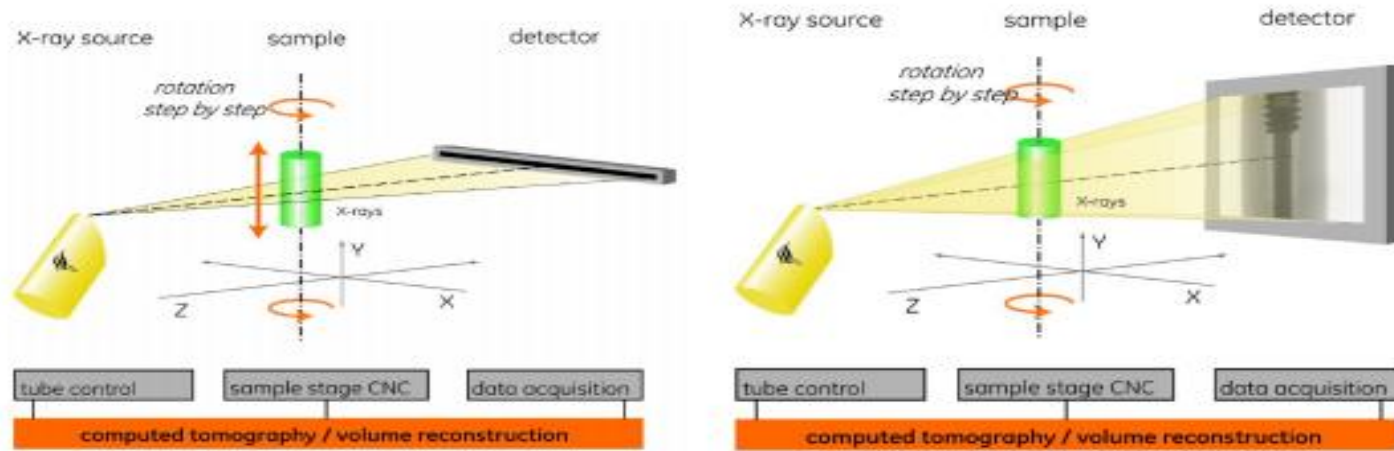
Introduction

What is the CT?

Computed tomography (**CT**) is an imaging procedure that uses special x-ray equipment to create detailed pictures, or scans, of areas inside the body

Structure of CT machines

It contains 4 main parts: X-ray sources, rotary table, X-ray detector and a data processing unit for computation, visualization and data analysis of measurement data
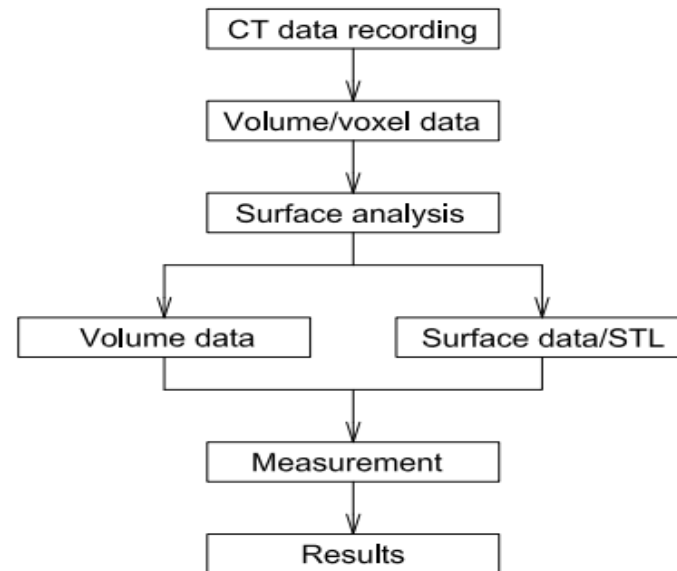
Principle of CT

(a) 2D-CT using line detector.

(b) 3D-CT with flat panel detector.

CT data recording

Volume/voxel data

Surface analysis

Volume data

Surface data/STL

Measurement

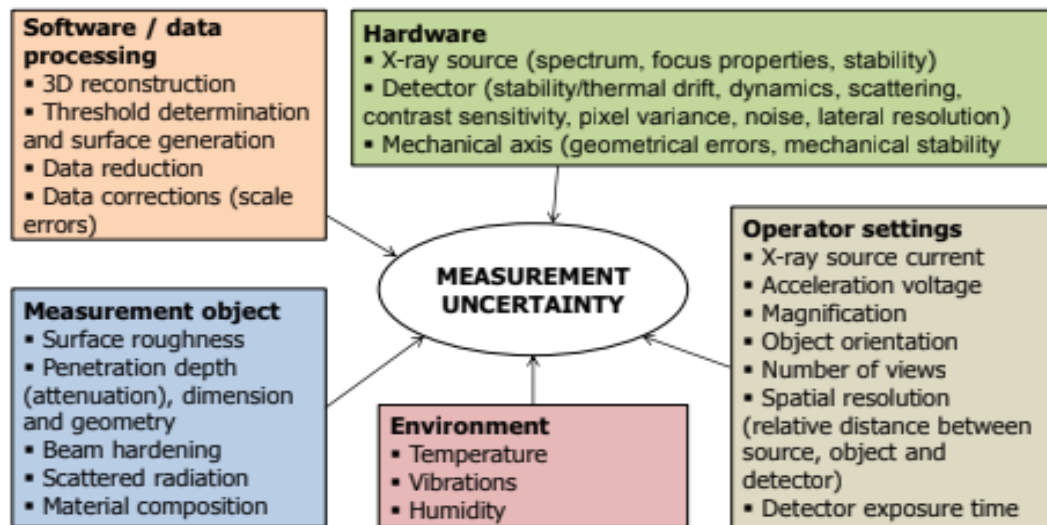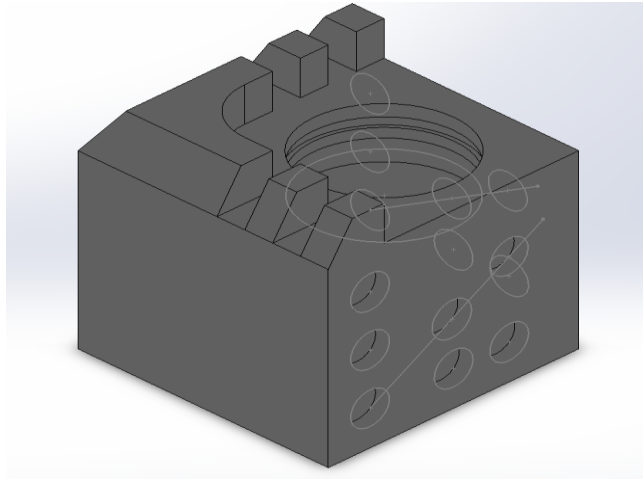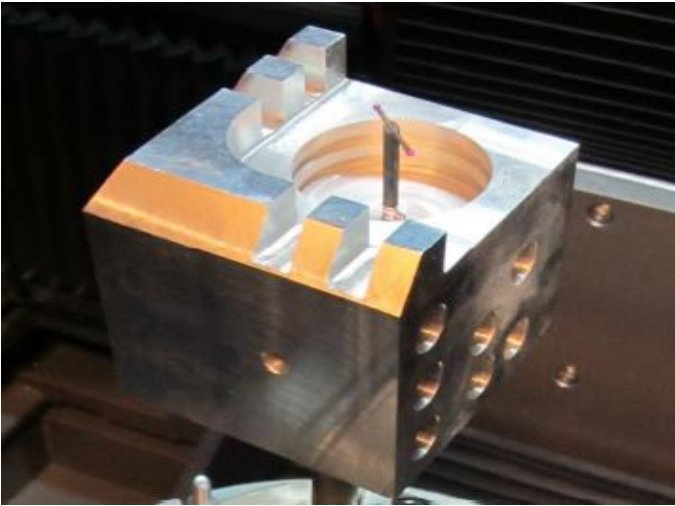Results

Influence factors

Figure 4.1: *Influence factors in CT.*

Previous Results

▶ Using VGS studio to measure dimensional parameter of a test work piece including: diameters, distance, flatness and perpendicularity.

▶ Specimen had 2 ball with distance of 15.9329 mm calibrated.

Previous results

Scanning with different modes including:

3 level of magnification: 2, 2.33, 2.72

3 level of number of views: 720, 1080, 1440

2 level of scanning mode:

level 1: U=250 kV; I=360 μA; Timing=330 ms; filter 0,5 mm Cu + 0,5 mm Sn

level 2: U=280 kV; I=250 μA; Timing=500 ms; filter 1 mm Cu + 0,5 mm Sn

Images created were processed by VGS studio to measure parameters including: diameters of 14 cylinders, flatness, perpendicularity and parallelism of 3 main planes : A, B and C

Result of actual semester

1. Publication.

   My first paper was accepted for publication in Novel Trends in Production Device and System VI with title of «Determination of GD&T Features Varying the Setting Parameters of X-Ray Computed Tomography by Response Surface Method»

   In the article, parallelism, perpendicularity and flatness of only 3 mains planes, diameters of 14 cylinders and distances between them were taken into account.

   The results were analyzed by Minitab and displayed under 3 main features: individual value plots, main effect plots and statistical evaluation by ANOVA analysis
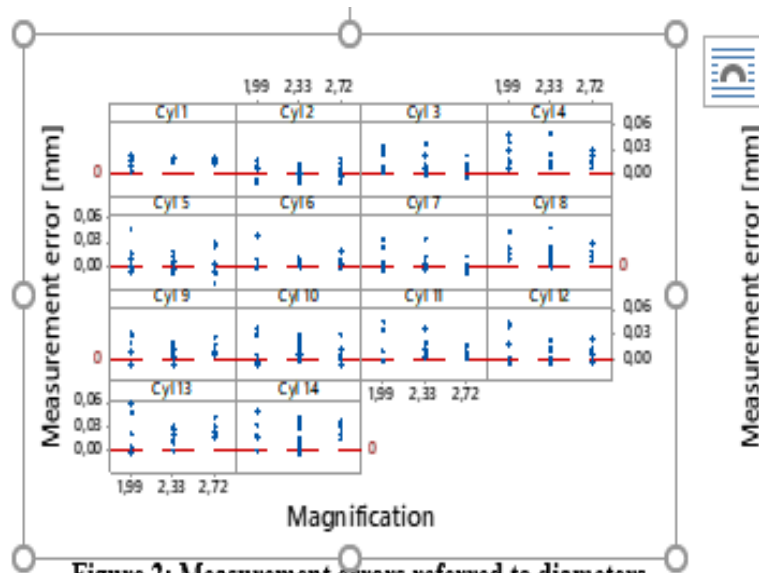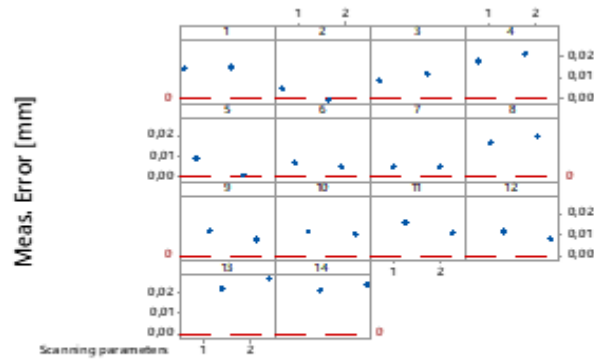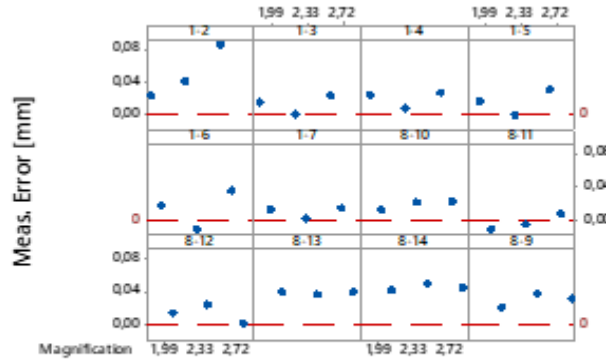
Figure 2: Measurement errors referred to diameters classifying by magnification
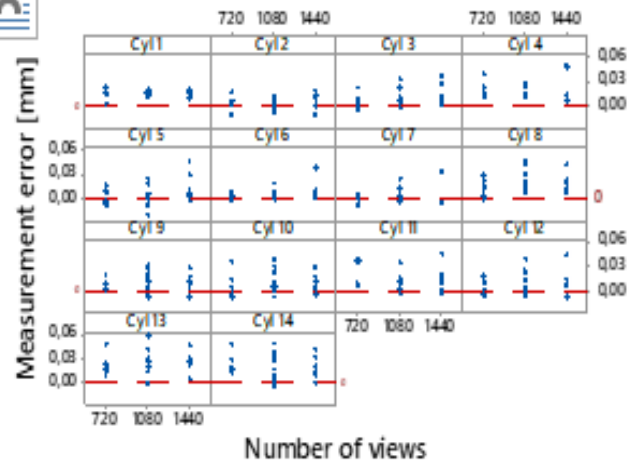
Figure 3: Measurement errors referred to diameters classifying by number of views

Figure 8: Mean meas. error for diameters classifying by scanning parameters

Figure 9: Mean meas. error values for distances classifying by magnification

▶ Equation of ANOVA analysis:

$$Meas.\,error = \beta_0 + \beta_1 \cdot M + \beta_2 \cdot NoV + \beta_3 \cdot SP + \beta_1 \cdot \beta_2 \cdot M \cdot NoV +$$
$$+ \beta_1 \cdot \beta_3 \cdot M \cdot SP + \beta_2 \cdot \beta_3 \cdot NoV \cdot SP + \beta_{11} \cdot M^2 + \beta_{22} \cdot NoV^2 + \varepsilon$$

Table 3: Table of significant factors at 95% (the significant factors are denoted by x)

Feature	M	NoV	SP	M·NoV	M·SP	NoV·SP	M·M	NoV·NoV	SP·SP
Cyl 1						x			
Flatness (A)	x						x		
Flatness (B)	x						x		
Flatness (C)	x						x		
C⊥A				x		x			
1-2					x				
1-4				x					
1-5			x						
1-6			x			x	x		
1-7			x						

Conclusion:

- Number of views has no significant effects on those features.

- Magnification affects considerably to flatness: smaller magnification caused larger errors of flatness.

- The second scanning mode gives better results in measuring perpendicularity with smaller errors. Several cases of distance between cylinders also show the influence of scanning modes.

- Diameters of cylinders are not affected significantly by any of three factors of settings.

Plan for the next semester

- Investigation on effect of temperature change at postion of rotary table to measurement errors

- Investigation on difference of surface roughness between pratical cases and using CT scanner.

- Publish paper related to two above topics

- Complete 2 last subjects and prepare for complex exam

Thank you for listening