# Study on Algorithm of Reconstructing Topography Based on Topography Difference

PhD Student: Xin CHEN

## Objectives

- To reconstruct topography based on topography difference, two algorithms are studied
  - Spatial frequency domain method (SFR)
  - Matrix equations method (EQU)
- Measurement method: Scan topography twice using two probes with intervals $D_1$ and $D_2$ so that two sets of topography differences are obtained

$D_1$ first scan
topography    difference 1

Combination

$D_2$ second scan
topography    difference 2
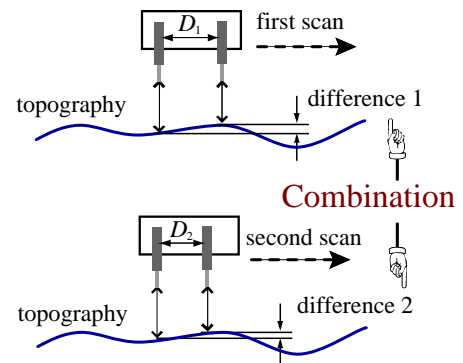
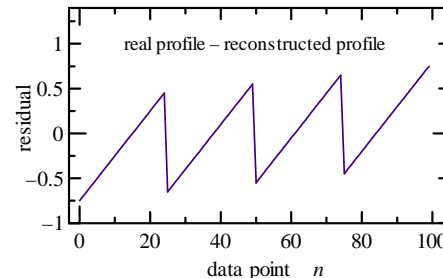## Spatial frequency domain method

- A new condition of parameters is derived ( $L \times s = P \times D_1 \times D_2$ )

| scan length $L$ | sampling interval $s$ | coefficient $P$ | probe interval 1 $D_1$ | probe interval 2 $D_2$ |
|---|---|---|---|---|
| 200 mm | 0.5 mm | 10 | 4 mm | 2.5 mm |

- Calibration of systematic errors is achieved in the presence of random errors
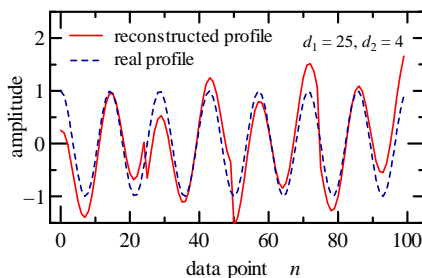
Simulation result without calibration of systematic errors

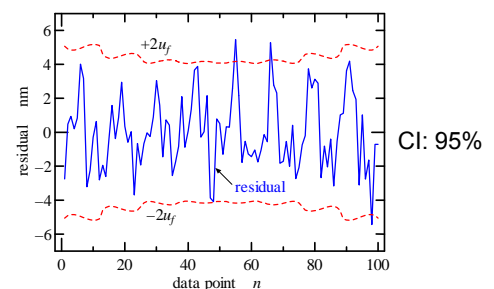Residual which gives agreement to theoretical calculation

## Matrix equations method

- Uncertainty is calculated and confirmed by simulations

$$Y = AX + \varepsilon \qquad S_p = (A^T S^{-1} A)^{-1}$$

- Available parameters is selected in two cases
  - Select available distance sensors and angle sensor to ensure a satisfied uncertainty
  - Select available sensor intervals to ensure a satisfied uncertainty

uncertainty (red) and simulation result (blue)

CI: 95%

Ref.) X.Chen, K.Kotani, K.Takamasu: Study on algorithm of reconstructing topography based on topography difference, Euspen2007, Bremen, Germany, 2007