

Fast Image Matching based on Fourier-Mellin Phase Correlation for Tag-Less Identification of Mass-Produced Parts

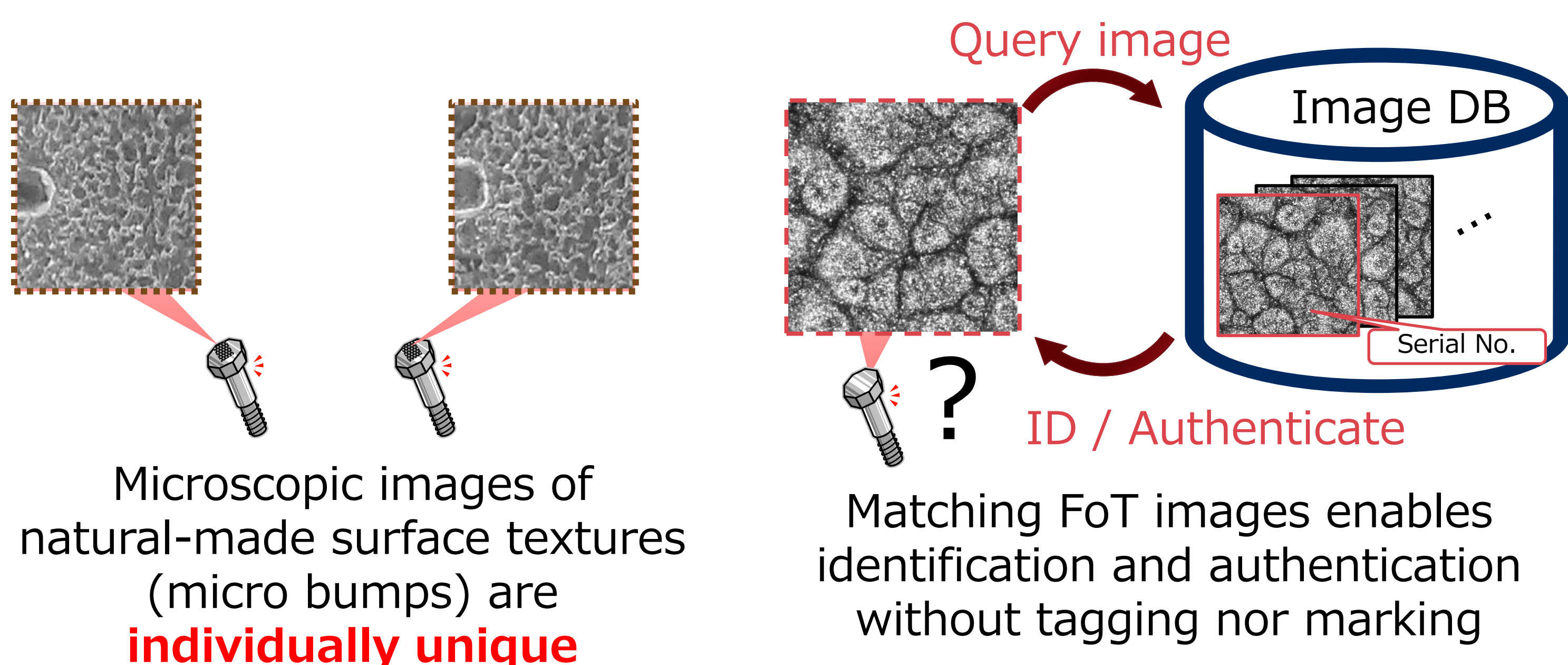
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Objective: Parts identification using “Fingerprint of Things” image matching

- **Background:** Growing demands for traceability of industrial products and their internal parts
- Tagging or marking is not allowed for many inside parts due to size, cost or their functionality

Solution: biometrics-like ID by image matching

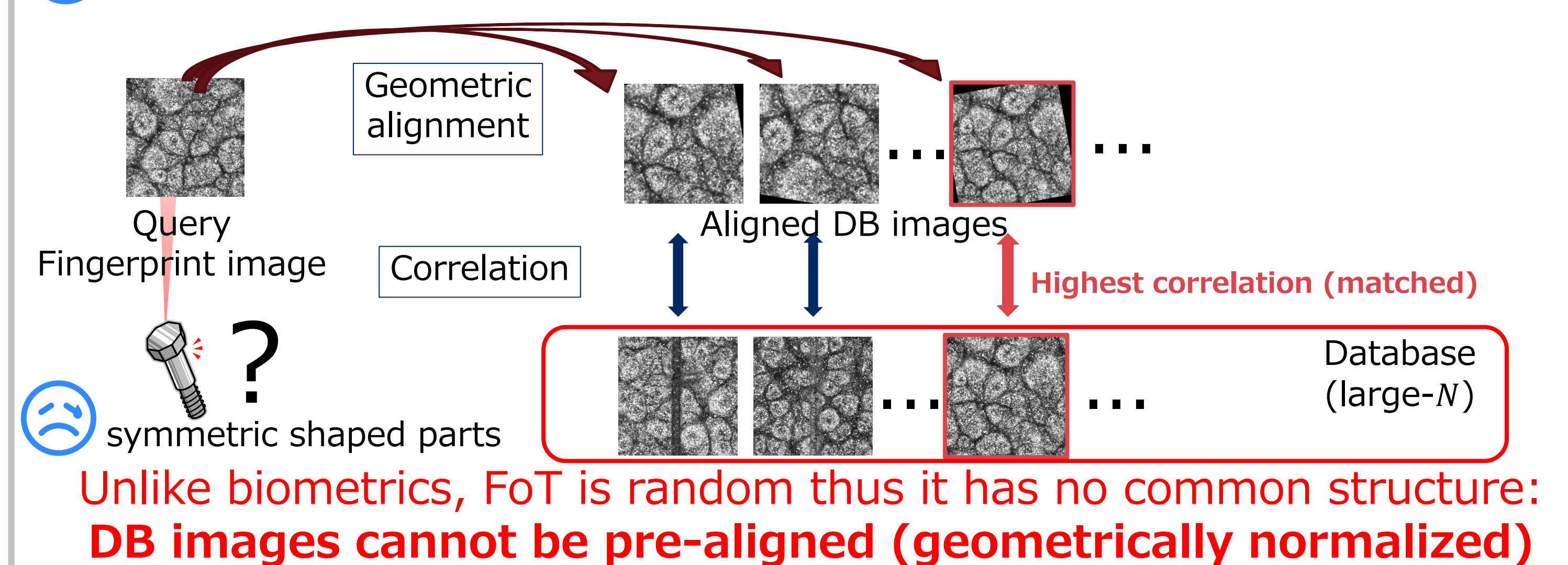
😊 Non-additive and zero-cost: useful ID for inside parts



Problem: Matching numerous random patterns under geometric changes

Conventional methods = alignment + correlation

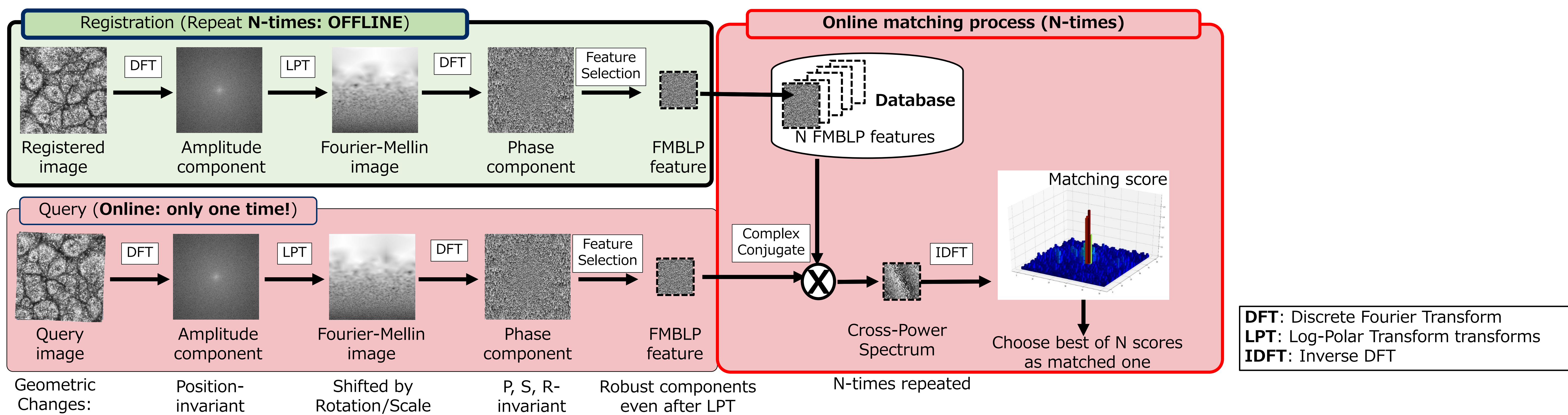
😞 **N (Large!) alignments required online for 1 query**



FAST matching of random patterns under geometric changes is needed

Proposed method: Fourier-Mellin Band-Limited Phase (FMBLP) Correlation

- Fourier-Mellin phase correlation: Position, scale and rotation invariant image matching
- **Direct matching** based on correlation between query- and DB- **FMBLP** features **without alignment**
- FMBLPs of DB images are extracted offline: **Online process is much faster** than conventional methods

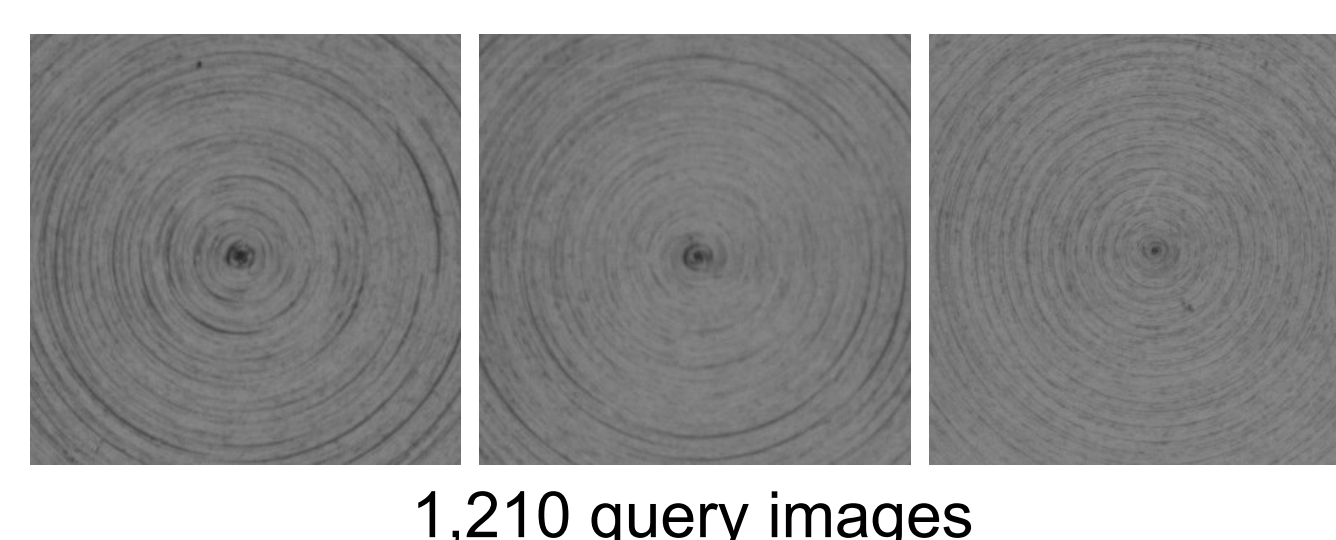
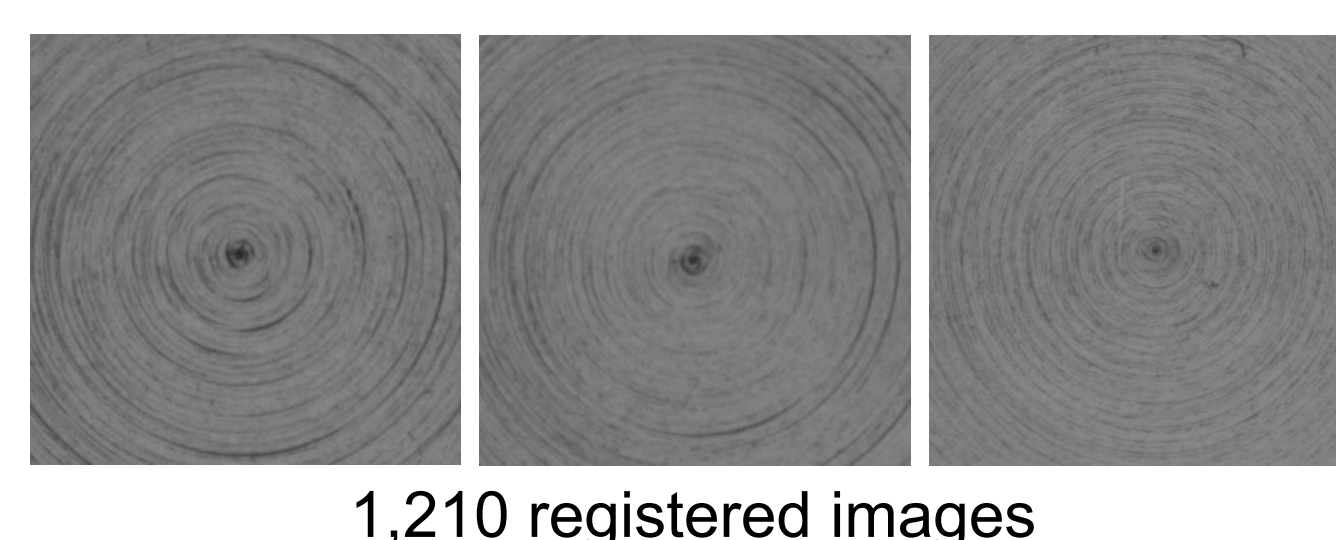
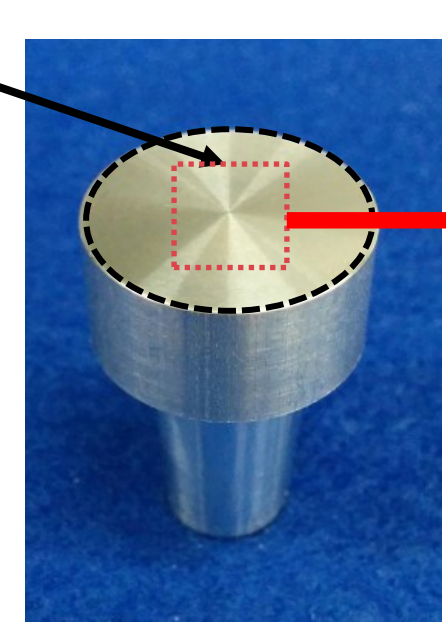
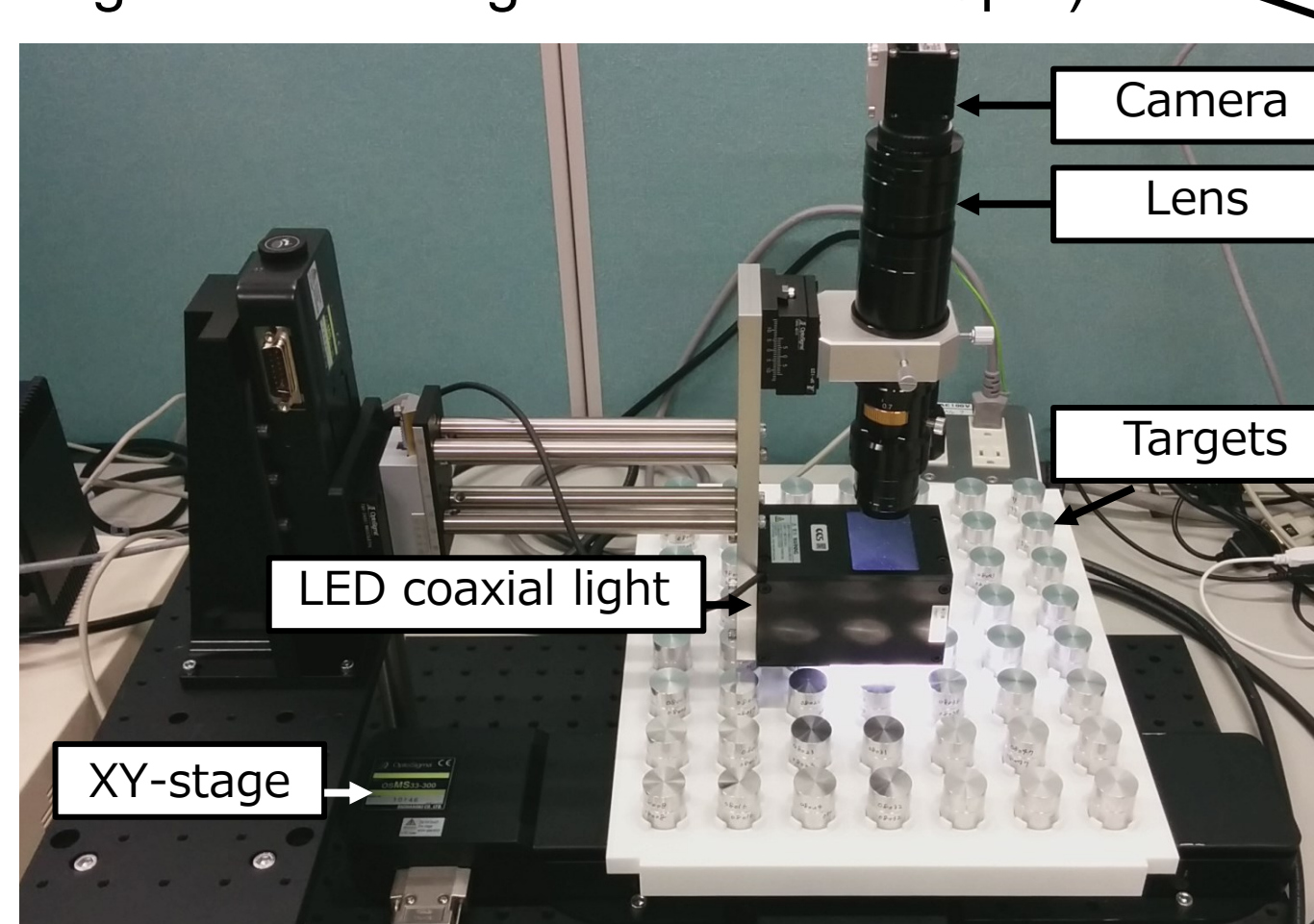


Experiments: 1-vs-1,210 matching in only 0.136 seconds and 100% accuracy

- Captured 1,210 pairs of images including position, scale and rotation changes
- ➔ **450 times faster** than conventional method and **perfect identification accuracy**

Target object: metal shafts

Precision metal parts made with NC lathe machine
(Average surface roughness: $R_a \approx 0.3\mu\text{m}$)



Online processing time for 1-vs-1,210 matching and Equal Error Rates

Methods	[sec]	EER[%]
Align + BLPOC [10]	62.0	0
FMP correlation	4.09	2.15
Proposed : FMBLP correlation	0.136	0

※CPU: Intel Core i7-3.6GHz, MEM: 32GB, OS: Windows 7 64bit
[10] A. Nikaido, et. al. IEEE ICIP 2007.