Development of Synthetically Generated LEA Signatures to Generalize Probability of False Positive Identification Estimates

Benjamin Bachrach, Roger Xu, Pan Gao & Guangfan Zhang

Intelligent Automation, Inc.

15400 Calhoun Dr., Suite 400, Rockville, MD 20855

Motivation

Several automated ballistics identification systems have been developed recently [1]~[5]. Although promising results can be found in these systems, only limited data have been used to develop and evaluate these systems. It is difficult to generalize the results achieved based on the limited data to a much larger population of firearms.

What is the probability that two bullets (tool marks) with this level of similarity could originate from two different barrels (tools)?

Goal

We are developing new tools to address this issue by creating synthetic Land Engraved Areas (LEAs). These synthetic LEAs would be constructed so as to resemble those found on a relatively small test set of LEAs sharing some common background. More importantly, the tail of the non-matching distribution can be better estimated with synthesized LEAs.
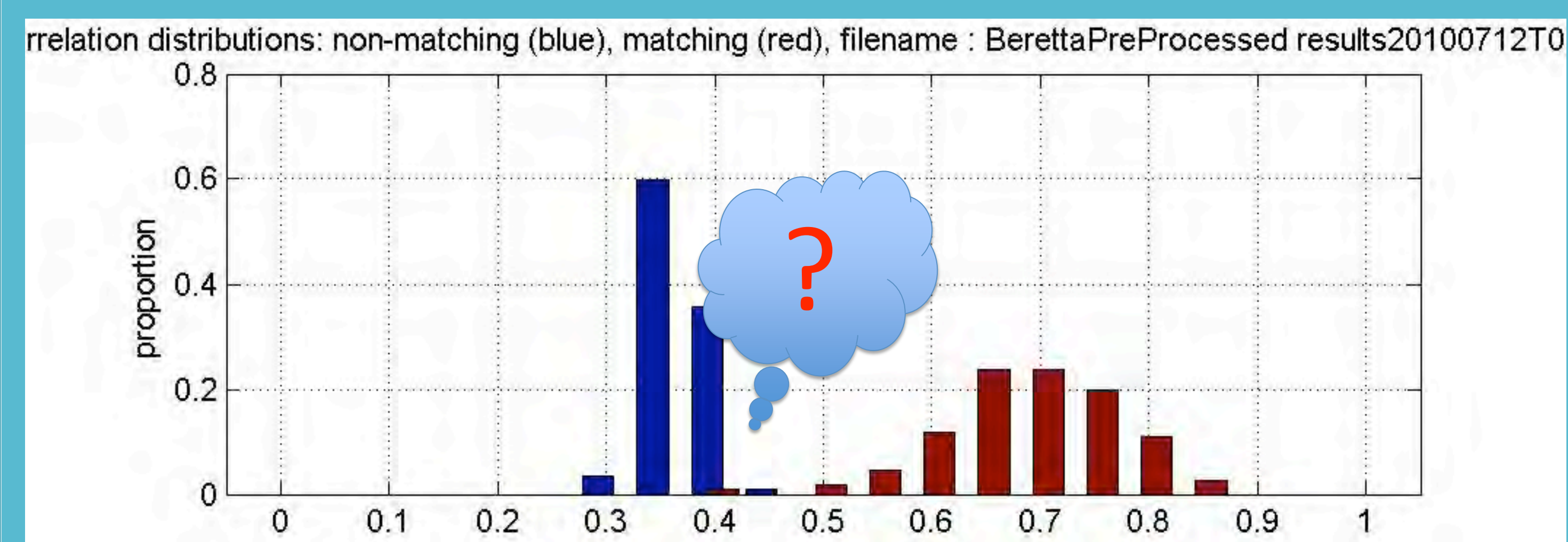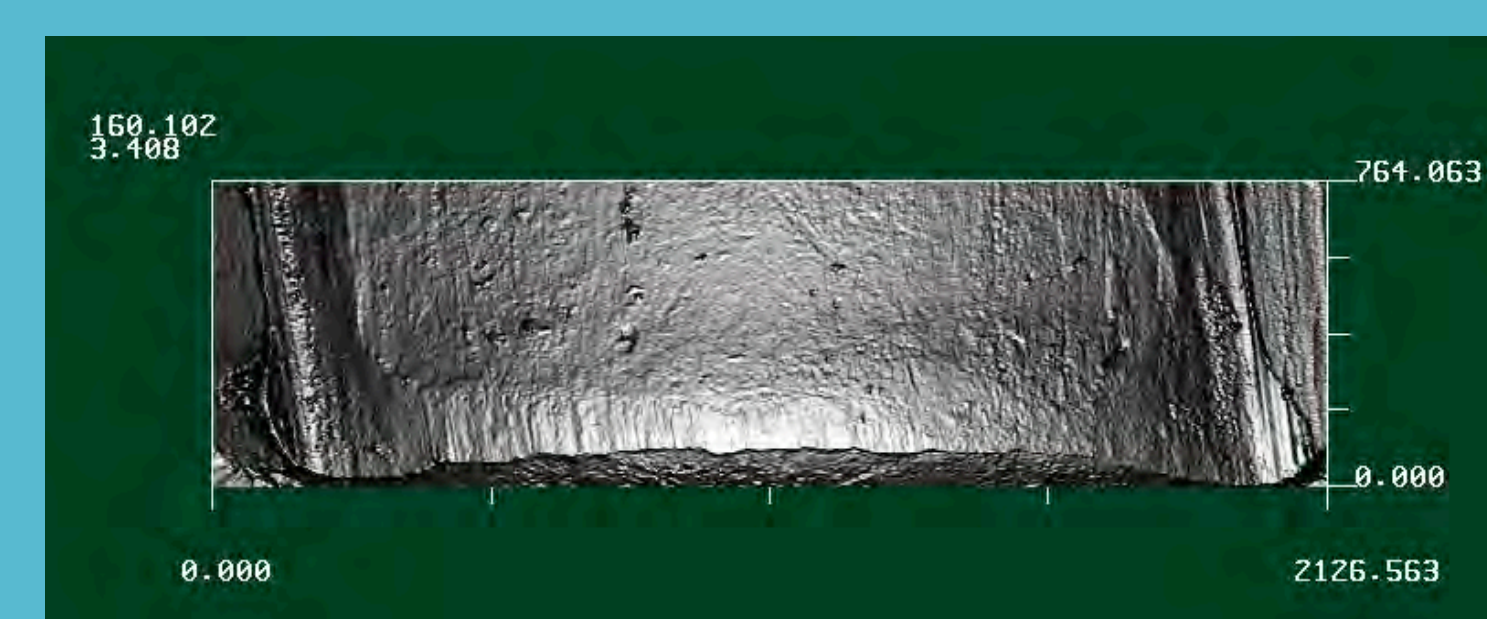

Architecture
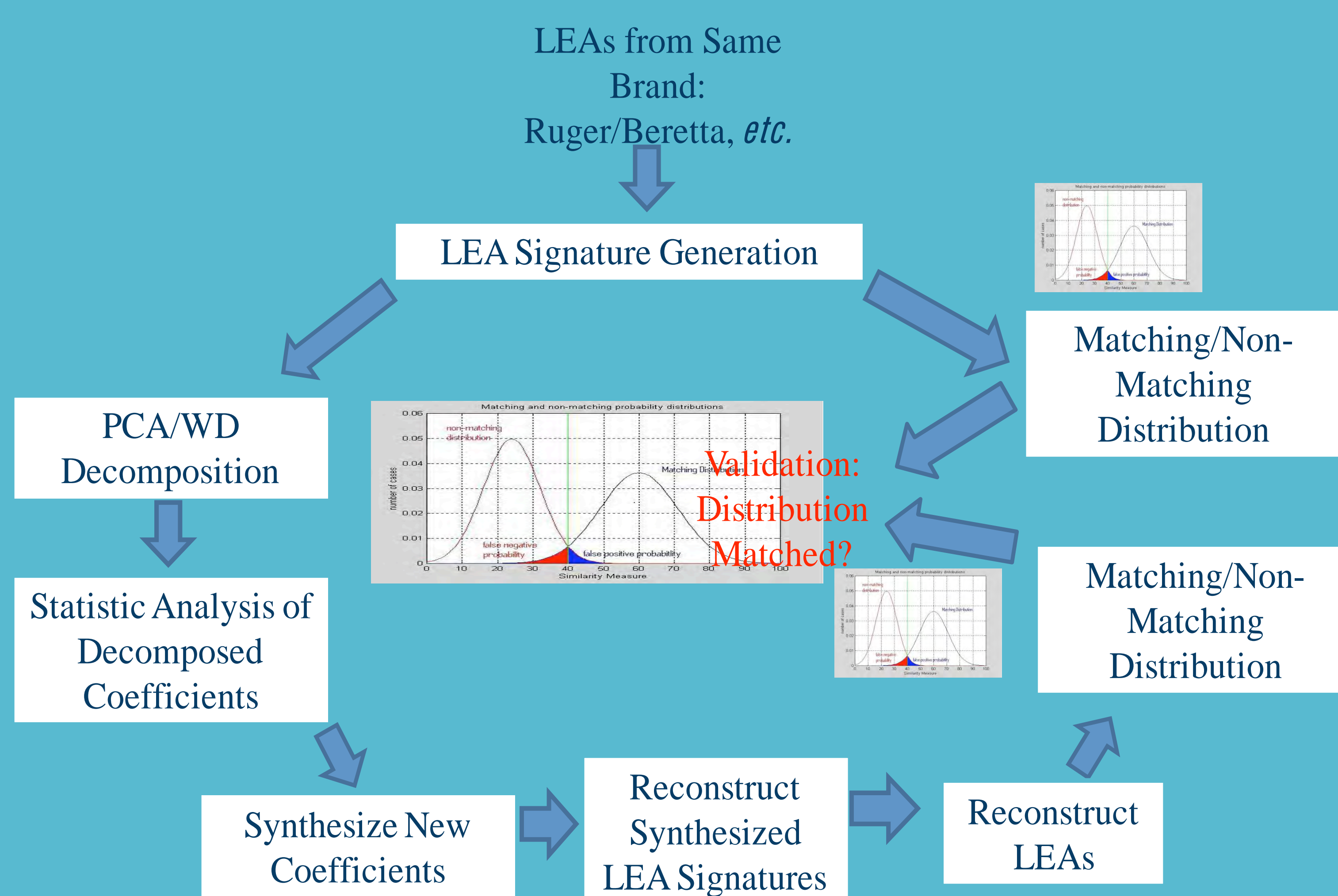
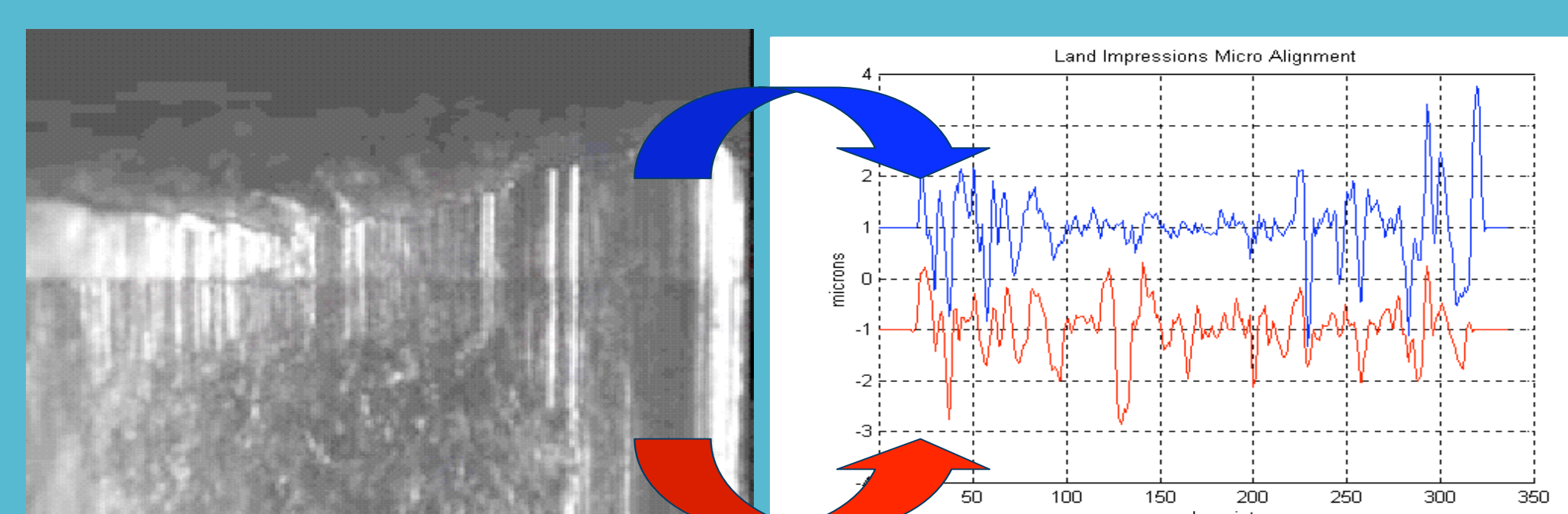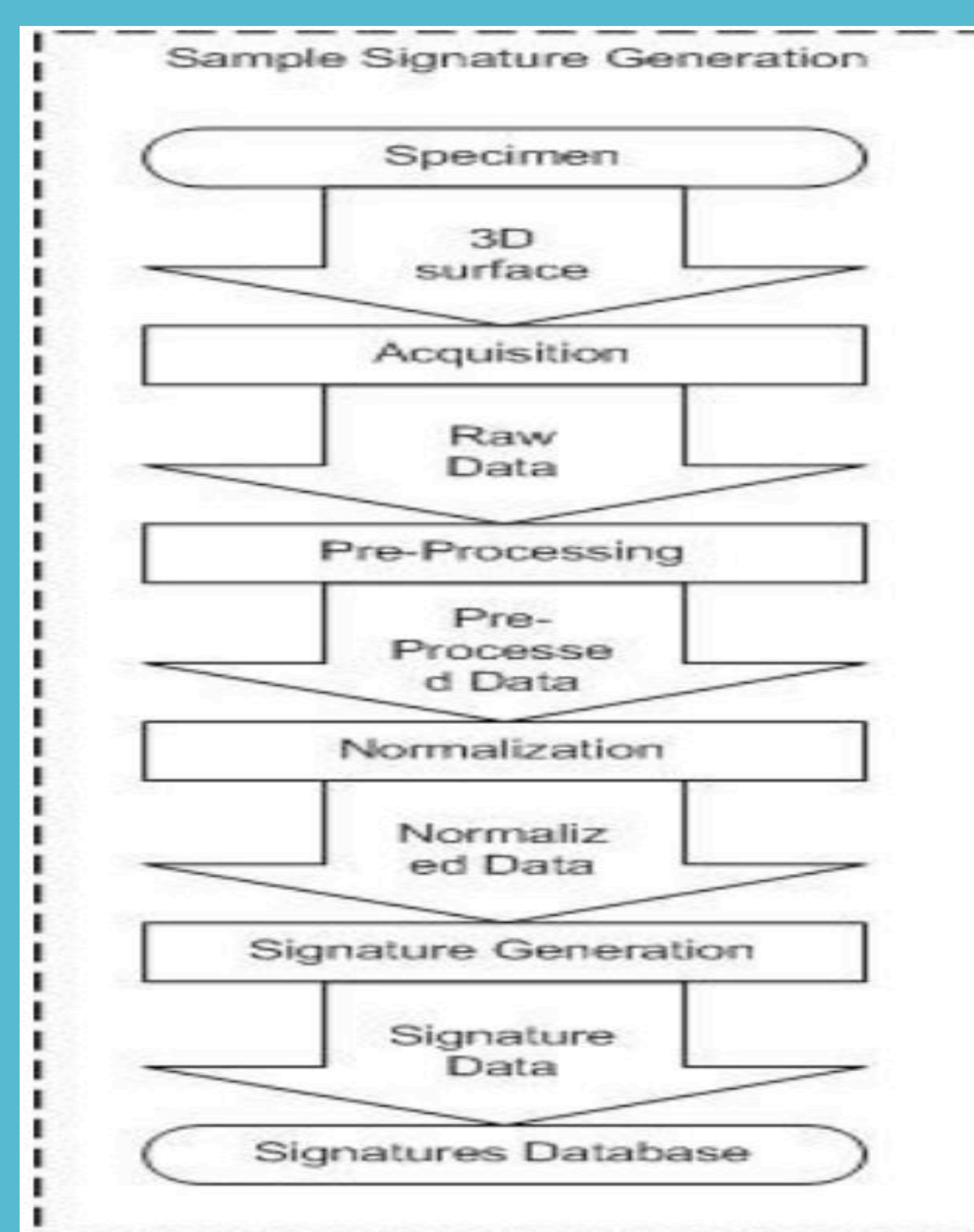## Synthetic LEA Signature Generation

• Assumption: bullets fired by the same barrel/ or barrels of the same brand have similar patterns in LEA signatures

• Procedures
   • LEA signature generation from a small set of LEAs
   • Characterize the patterns for the LEAs from the same sample set of barrel or brand
   • Synthesize LEA signatures
   • Recover LEAs from signatures

• Experimental data collected using MuSurf [6]
   • Principal: Confocal microscope
   • Data: 512X512 patch
   • Depth resolution: 20 nanometer
   • Lateral resolution: ~1.5 micrometer
   • Working distance: 12 millimeter

LEA Signature Generation

Software Development

(a) Image Tab   (b) 3D Model Tab
(c) Curve tab   (d) Combined Display Tab
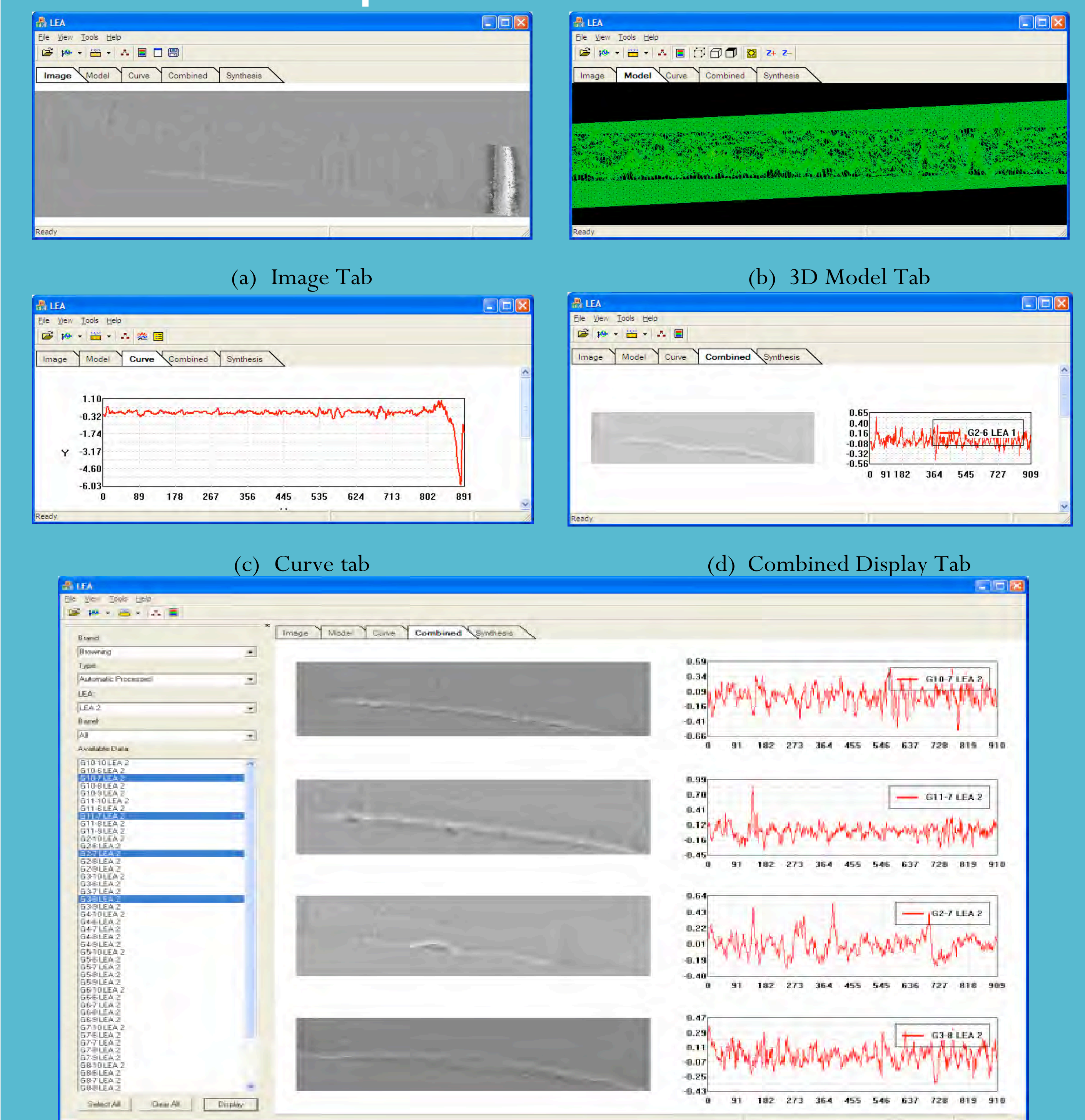
Conclusions

This research effort aims to develop a synthetic LEA signature generation system to generalize probability of false positive identification estimates.

References
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[3] Wei Chu, et. al., "Pilot study of automated bullet signature identification based on topography measurements and correlations," Journal of Forensic Sciences, Vol. 55, Issue 2, Page 341-347, 19 Jan, 2010
[4] F. Xie, et. al., "Automated bullet-identification system based on surface topography techniques," Wear, Vol. 266, Issue 5-6, 15 March 2009, pg. 518-522
[5] Fernado Puente, leon, "Automated comparison of firearm bullets," Forensic Science International, Vol. 156, Issue 1, 6 January 2006, pg. 40-50
[6] www.naofocus.de