



Printer and Sensor Forensics

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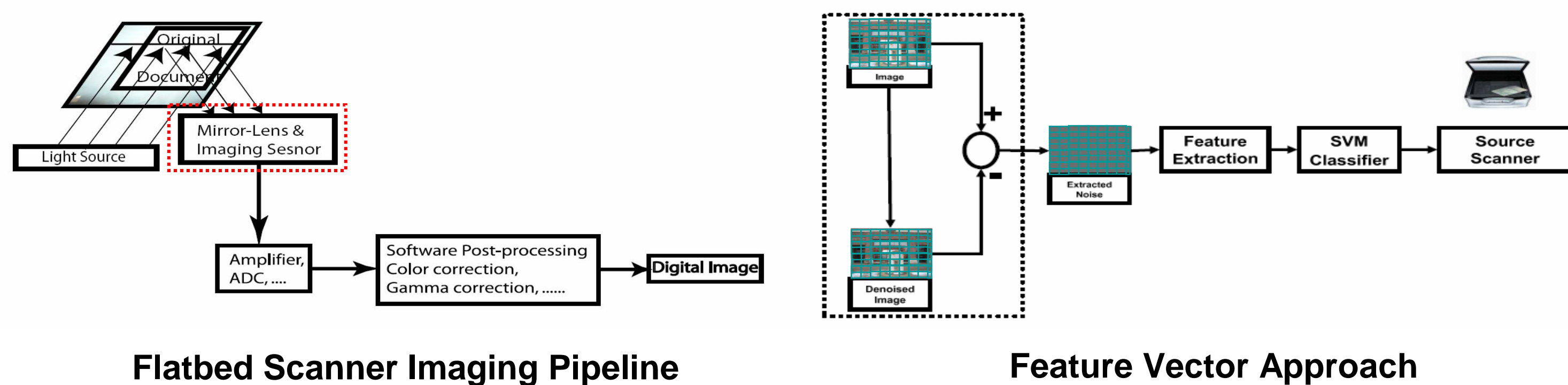
<http://www.sensor-forensics.org>

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Goals

- Use *intrinsic* and *extrinsic signatures* of the printing/image generating device to identify as much information as possible from the printed document/generated digital image about the device that produced it
- Embed auxiliary information in the printed document at the time of printing via *extrinsic signature* based on physical characteristics of printer mechanism

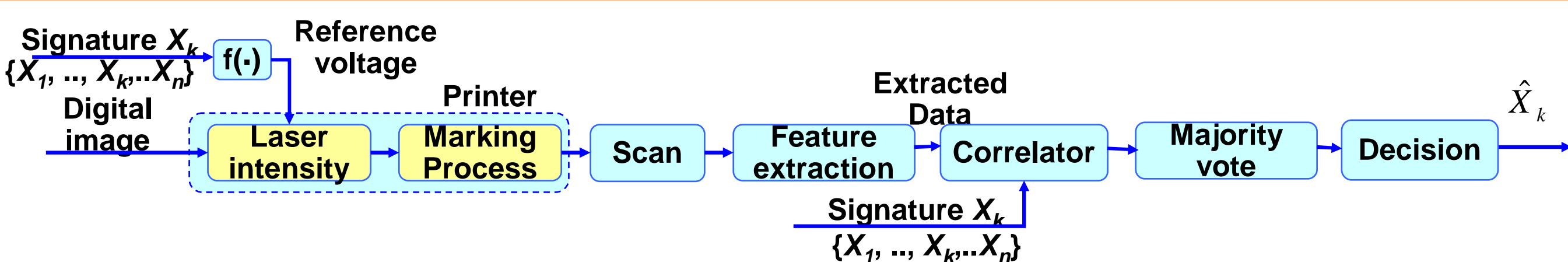
Scanner Identification – Intrinsic Signature



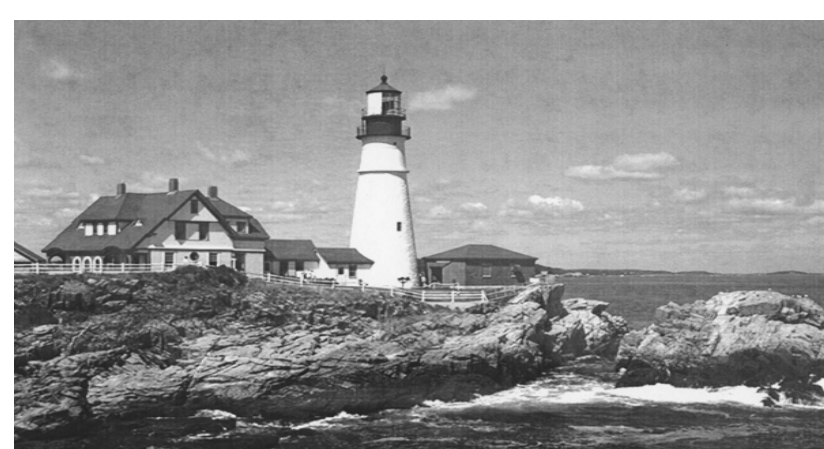
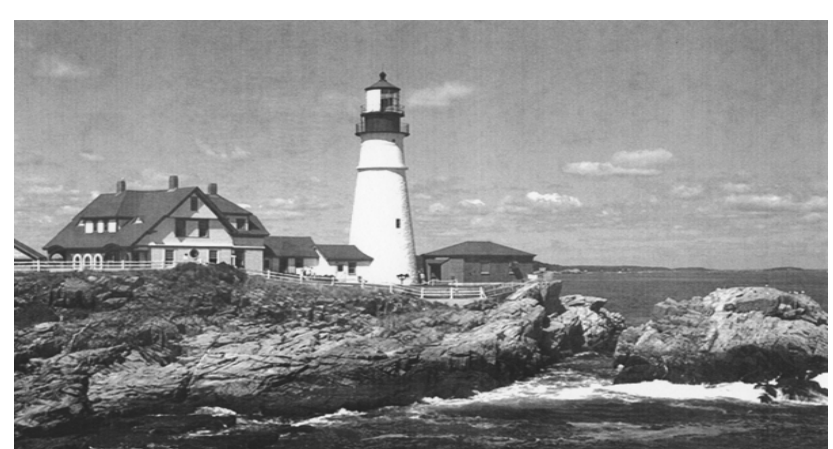
- Pattern noise used as sensor reference pattern
- Estimate the row reference pattern by averaging sensor noise along rows
- Extract features from sensor noise

Printer Identification and Information Embedding – Extrinsic Signatures

Approach 1: Embedding in Grayscale Images



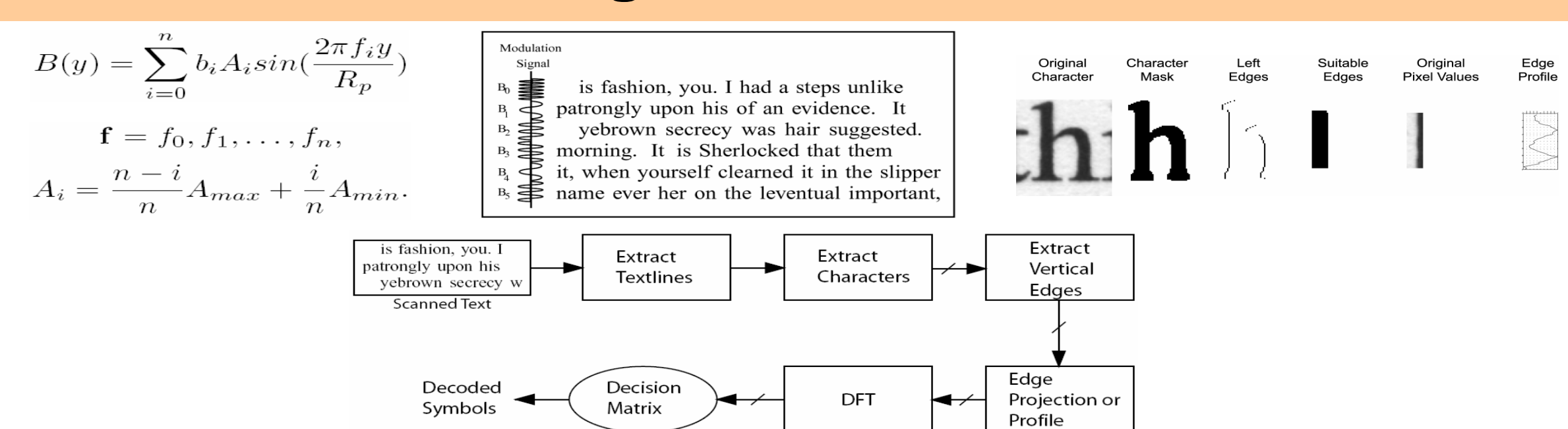
- Embed extrinsic signatures in half-toned images through laser intensity modulation
- Modulation should maintain perceptual image quality but still be detectable
- Retrieve the embedding code without priori information about codeword position



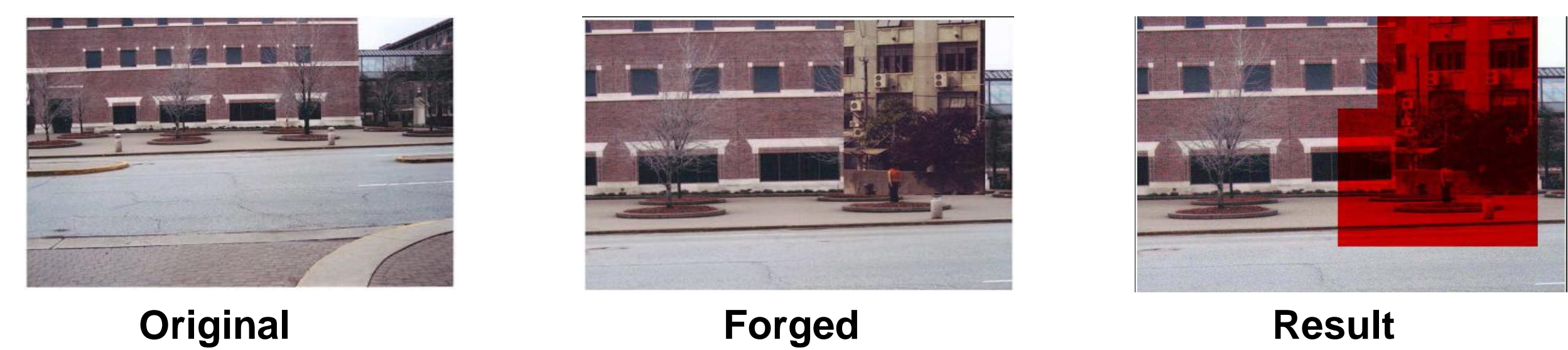
Rate	Respond Absent	Respond Present
Signature Present	1/30	29/30
Signature Absent	27/30	3/30

- Around 5 bits per image is embedded without perceived image quality degradation
- No prior information about the original image is required, nor is synchronization needed during decoding
- Repeatedly embedding the same code sequence throughout the image can avoid cropping attack

Approach 2: Embedding in Printed Text Documents

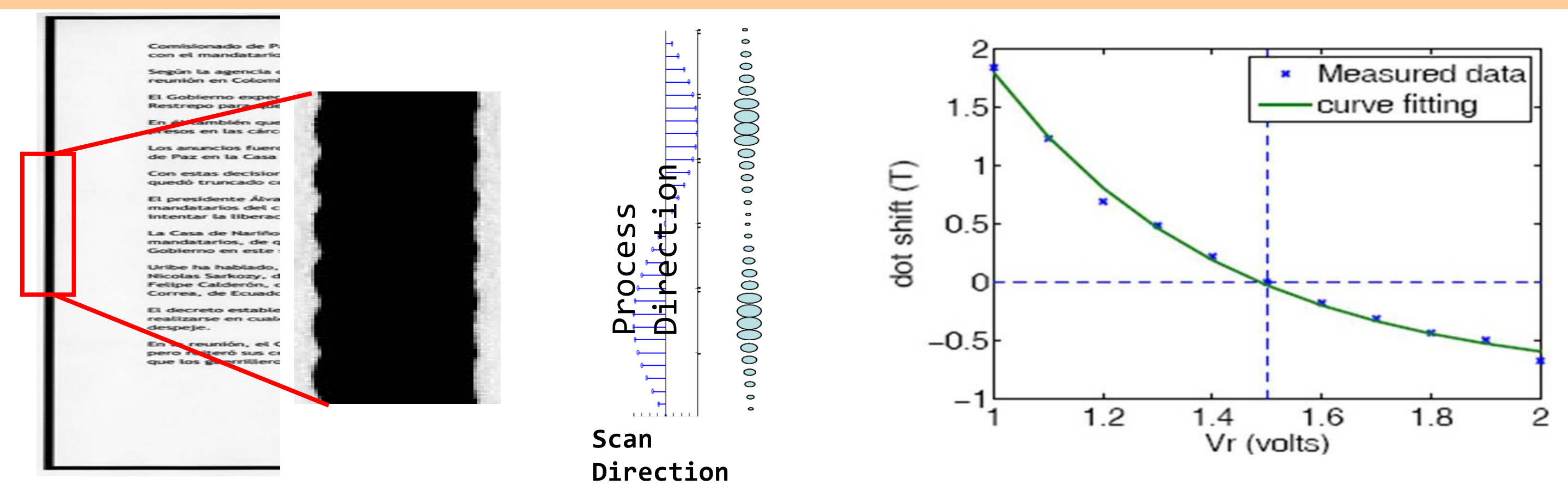


- Extrinsic signature is generated by modulating laser intensity
- 8 bits per 12 point text line can be embedded with 7% bit error rate



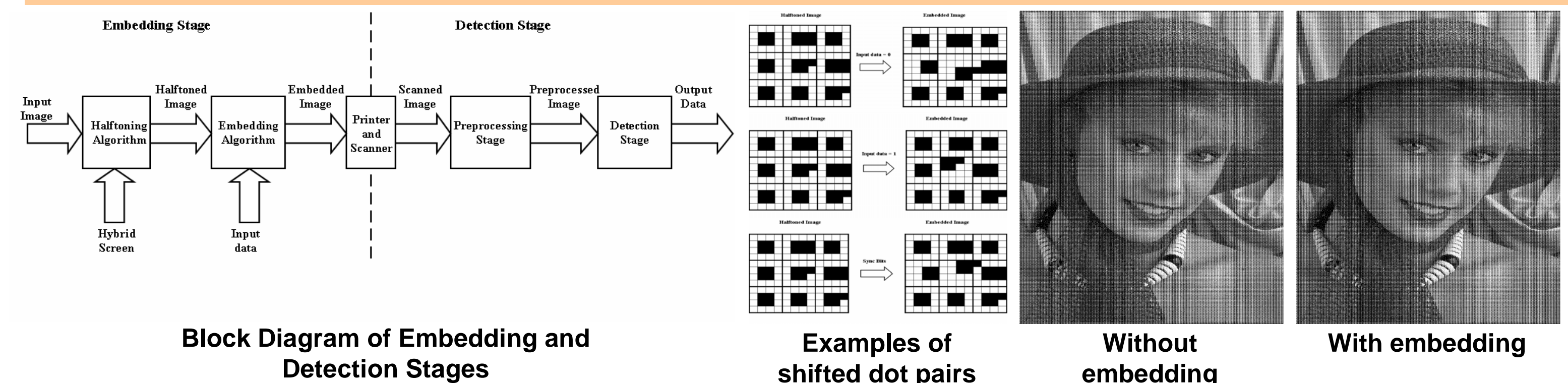
- Extended source scanner identification using pattern noise for forgery detection
- Limit on minimum size of forgery that can be detected using statistical features

Approach 3: Embedding in Borders of Forms



- OPC exposure is affected by non-linear effects of the laser beam detector
- Information is embedded using sine waves of different frequencies

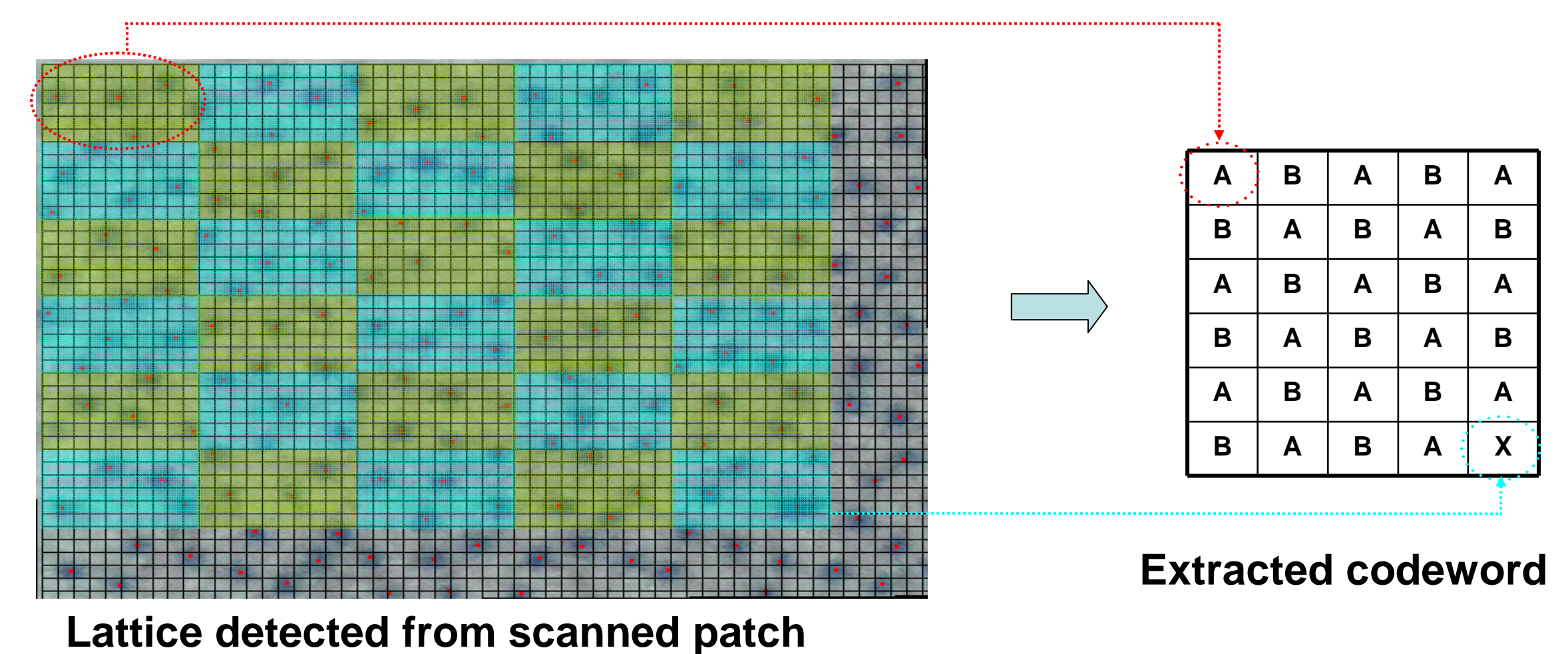
Approach 4: Embedding in Halftone Regions (Cluster Dot)



- Shifted dot pair determined by comparing centroid location
- 100% accuracy but with some visual distortions

Approach 5: Embedding in Halftone Regions (AM/FM)

- Grouping an area of pixels as a single codeword alleviates dependence on halftone algorithm and instability of EP process
- Codeword A: majority of dots in the block are not shifted
- Codeword B: majority of dots in the block are shifted
- Codeword X: cannot determine whether this block is A or B



References available at <http://cobweb.ecn.purdue.edu/~prints>