The Forensics of Things: Forensic Characterization Methods for Physical Sensing Devices

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Acknowledgments

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  - **Graduate students (Aravind Mikkilineni, Nitin Khanna, Pei-Ju Chiang, Sungjoo Suh, Maria Ortiz, Vivek Shah)**

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Device Forensics

- **Forensic characterization**
  - **– Observe device output ⇒ which sensor produced it?**
- **Device authentication**
  - **– Performed using forensic characterization**
  - **– Identify device type, make, model, configuration**
  - **– Can the sensor be trusted?**
- **Detection of data forgery or alterations**
- **Fingerprint and Trace**

Sensor Forensics Research

- **Printers**
- **Cameras**
- **Scanners**
- **Sensors Nodes**
- **RF Devices**

Sensor Forensics At Purdue

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

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» PSAPF «

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Purdue Sensor and Printer Forensics (PSAPF)

The goals of our work are to securely print and trace documents on low cost consumer printers such as inkjet and electrophotographic (laser) printers. Click on **About** on the menu at left for an overview of this project.

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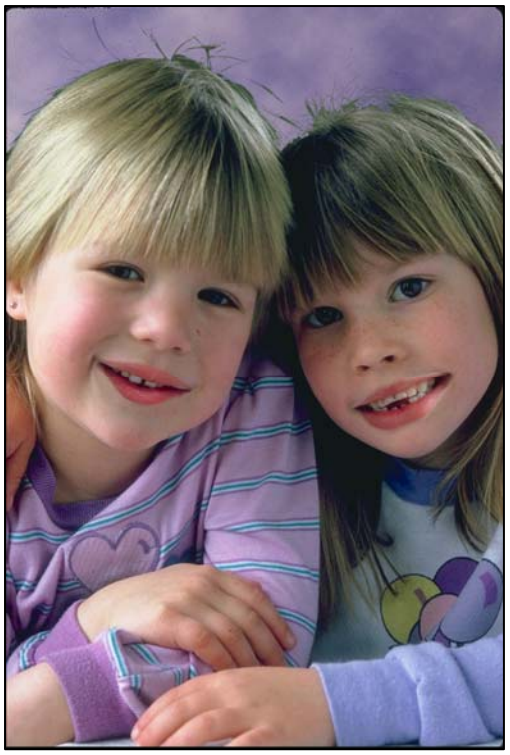
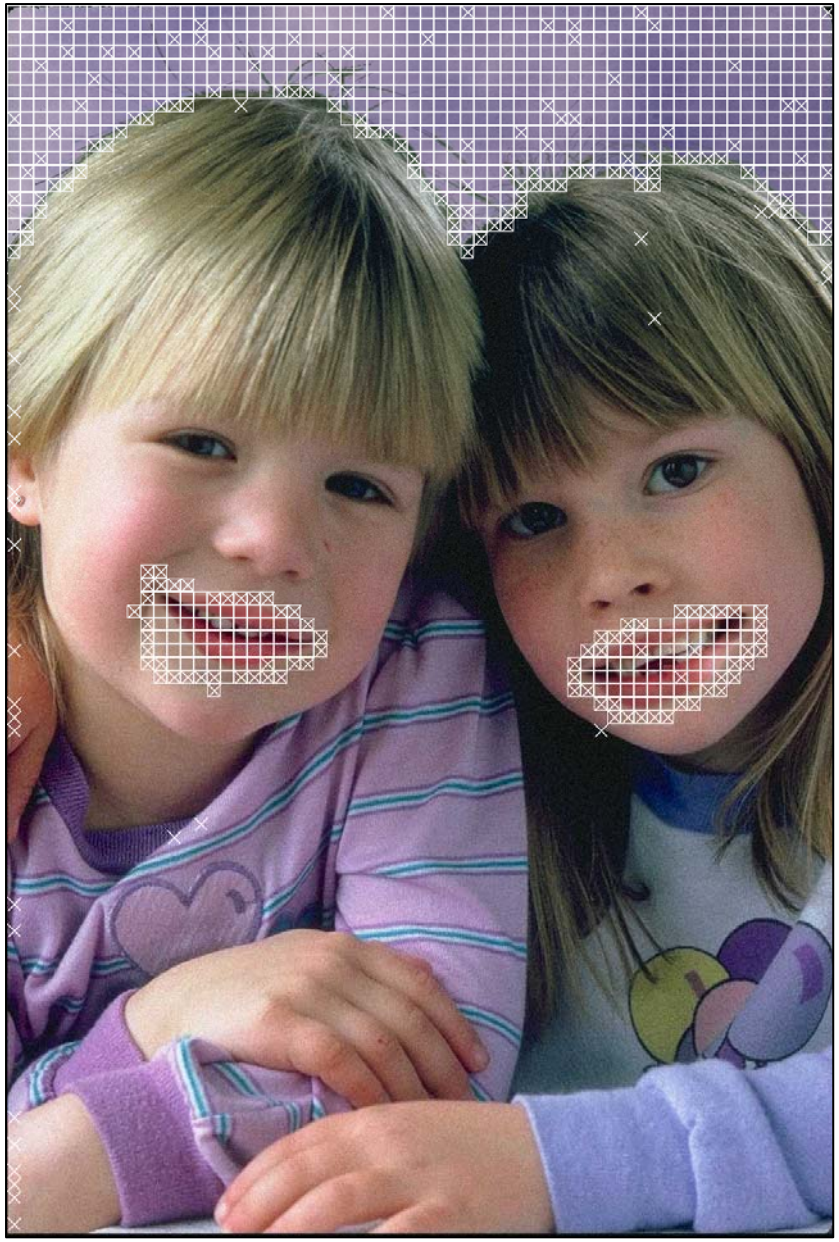
Camera/Image Forensics

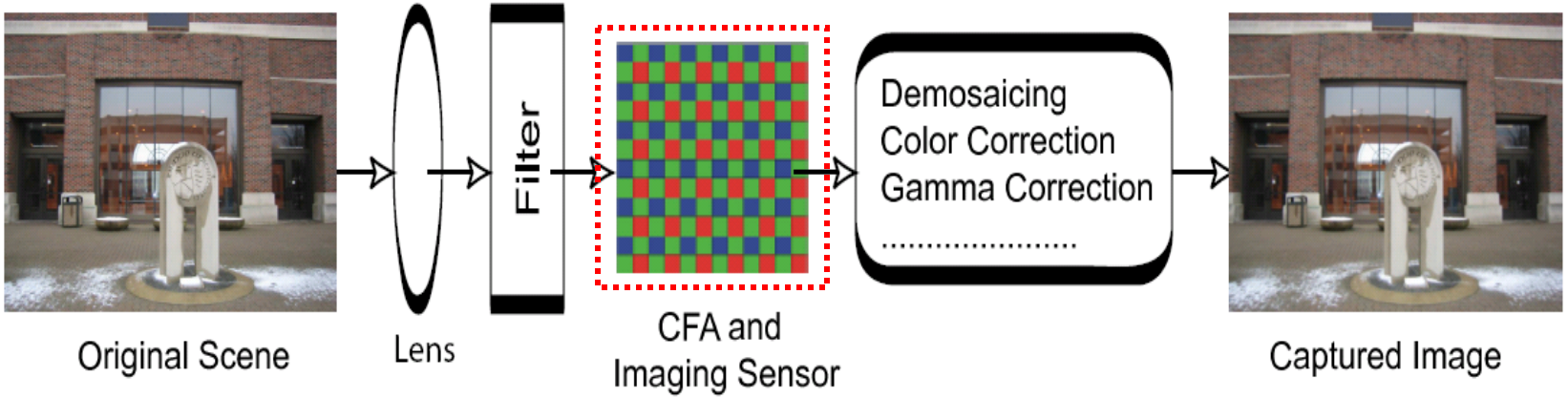
← Original “Girls”

Altered “Girls” →

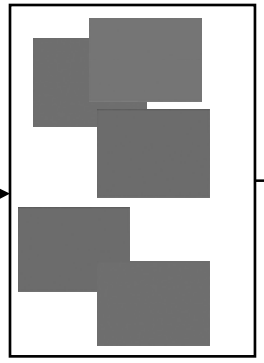


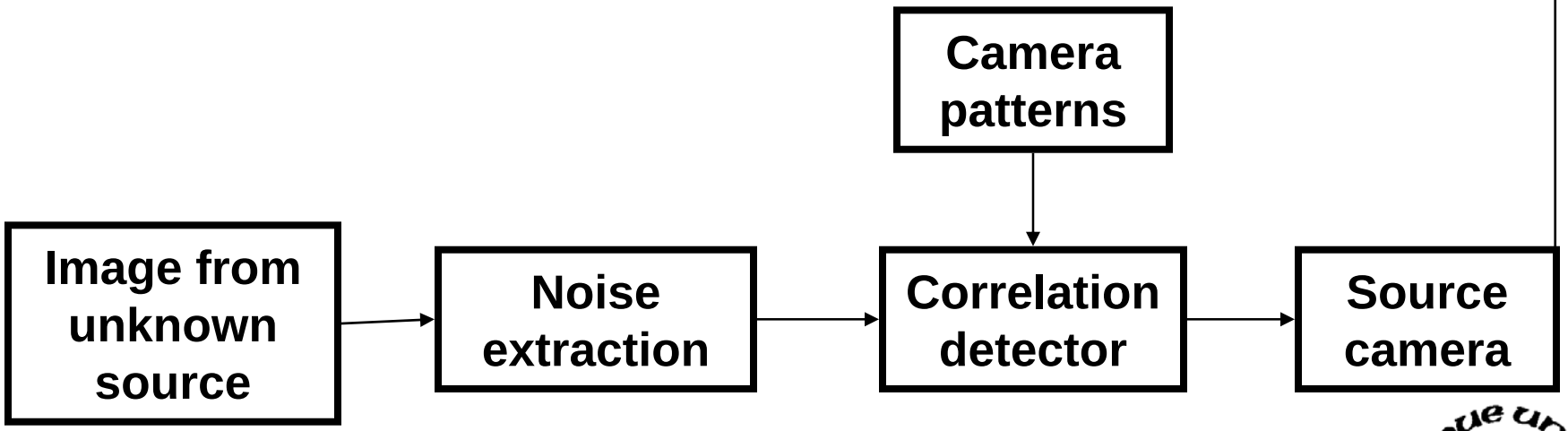


Digital Camera Imaging Pipeline

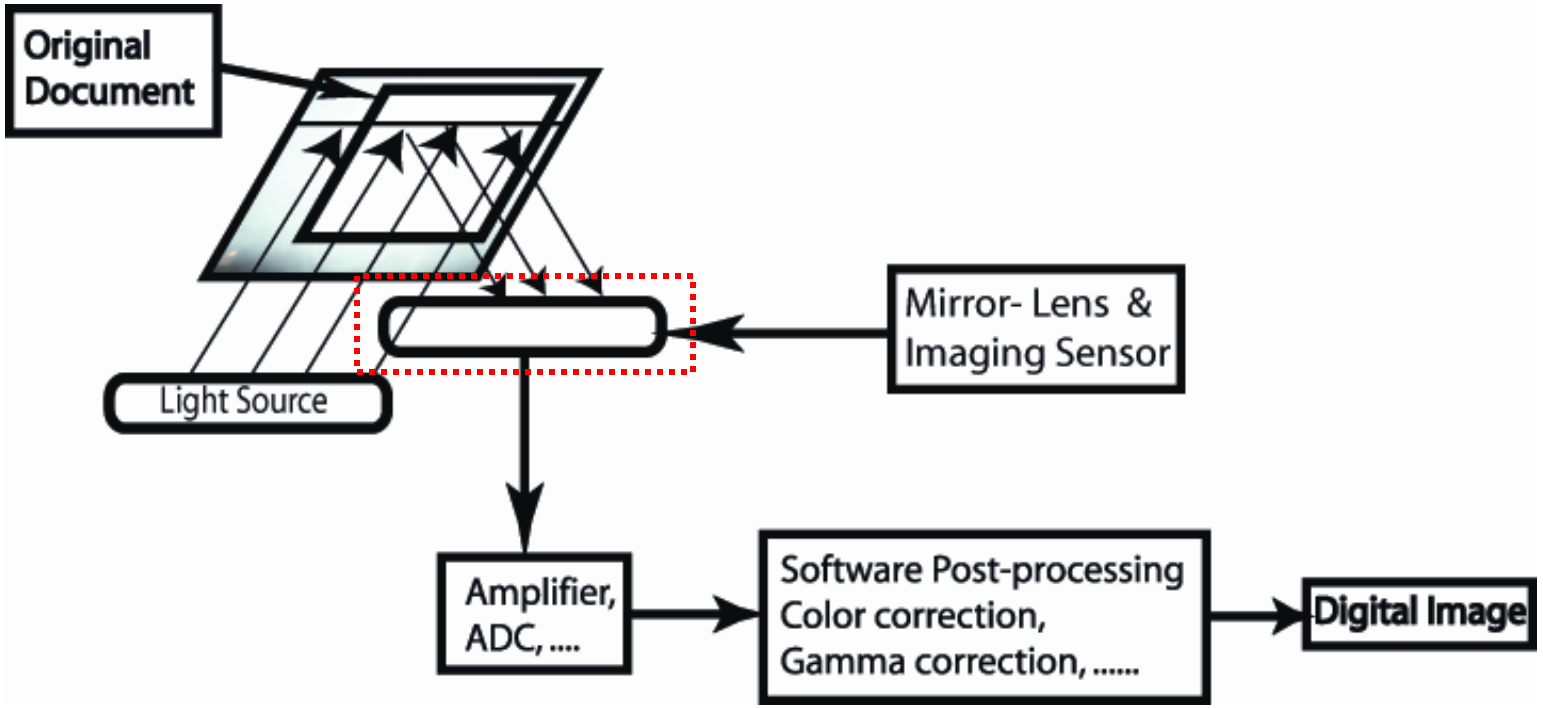


Camera Forensics

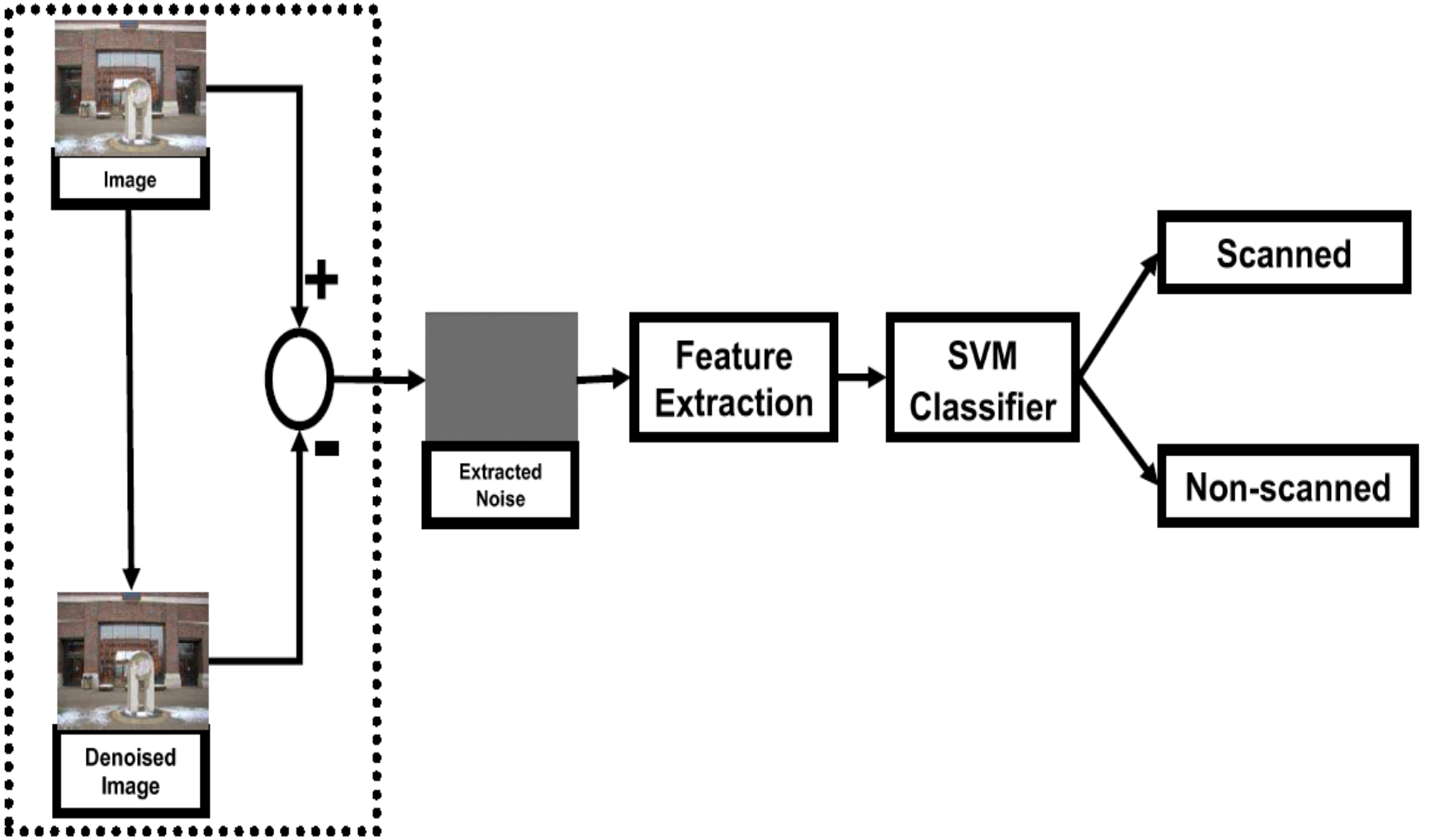




Flatbed Scanner Imaging Pipeline

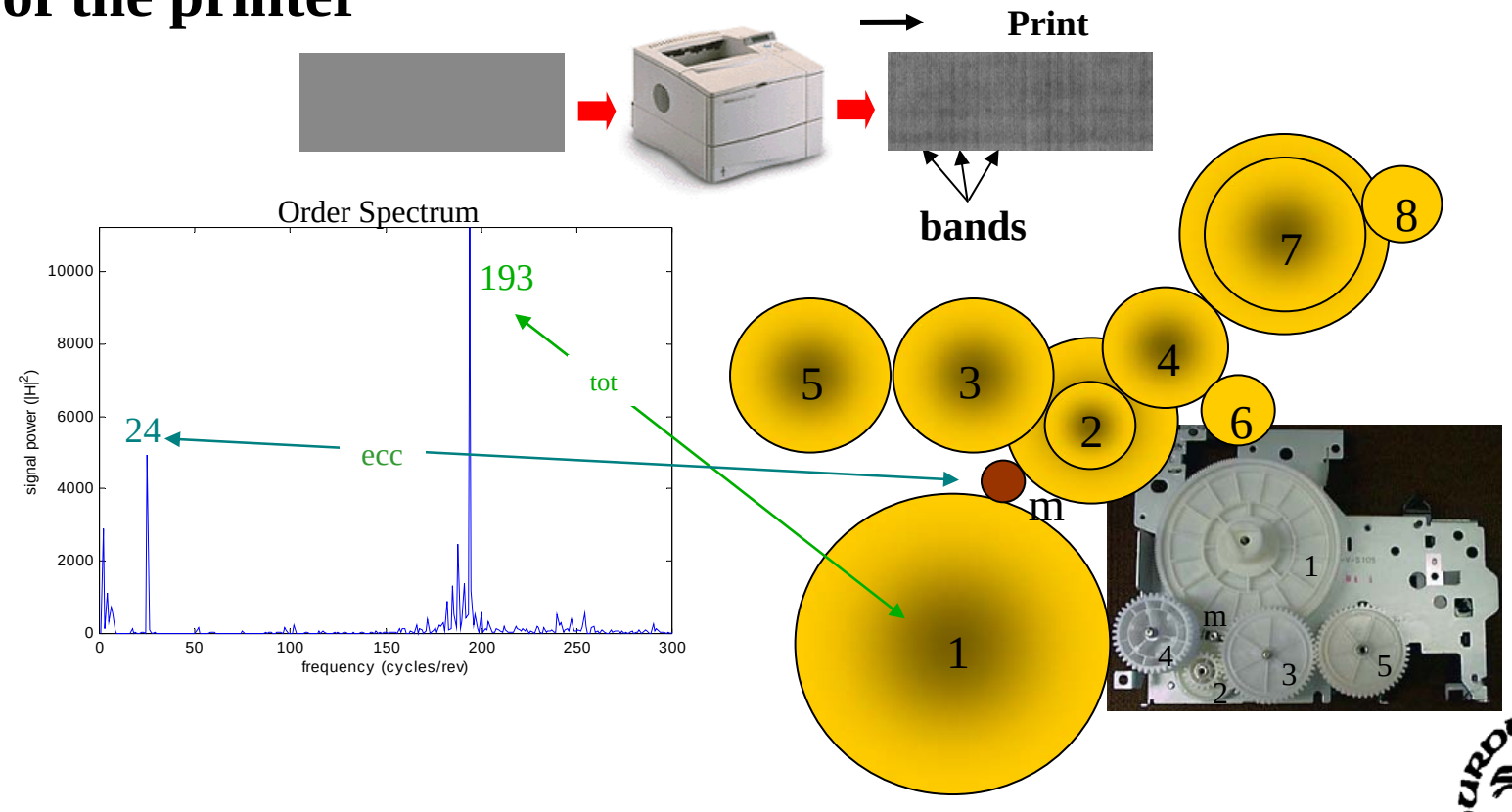


Source Determination

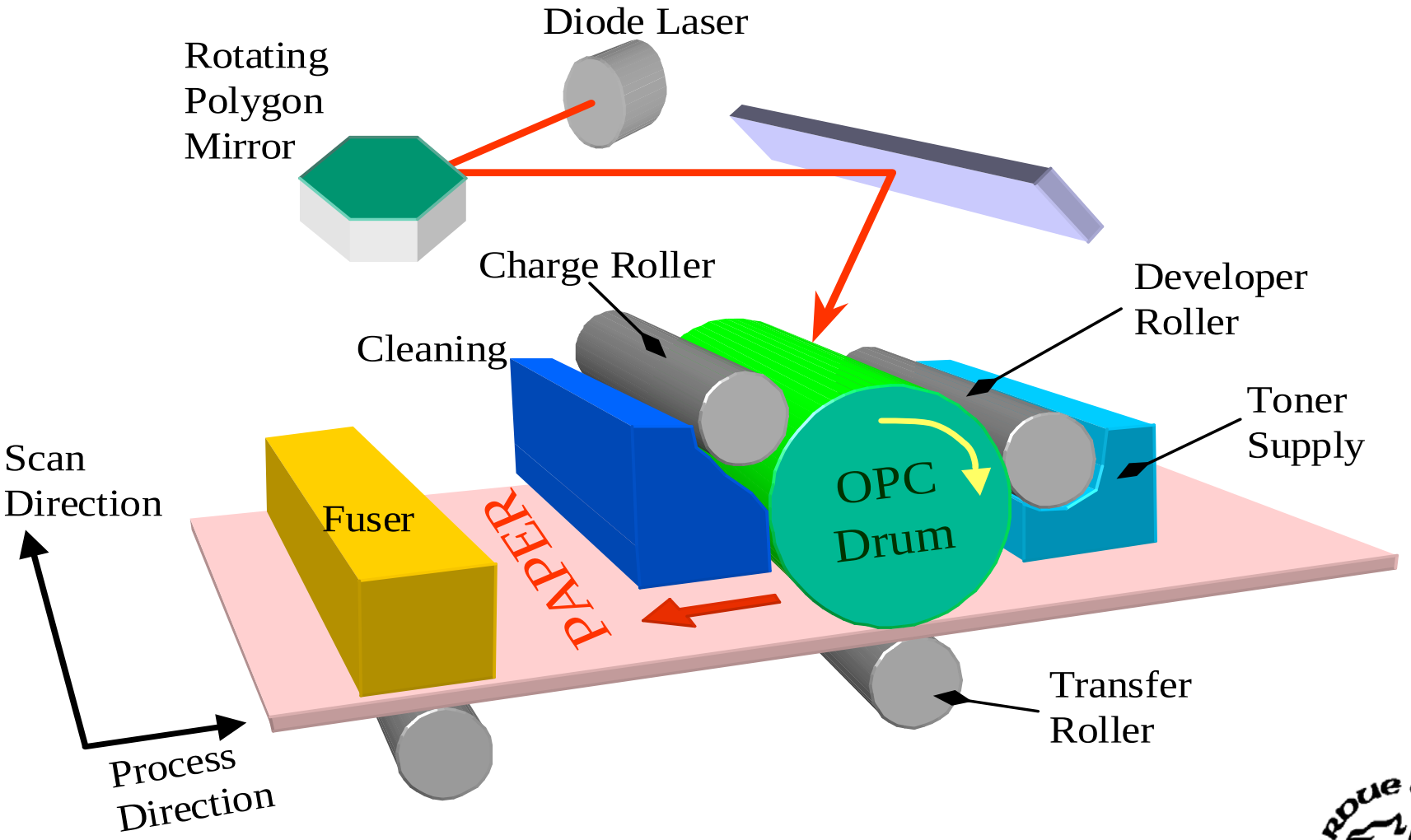


Printers

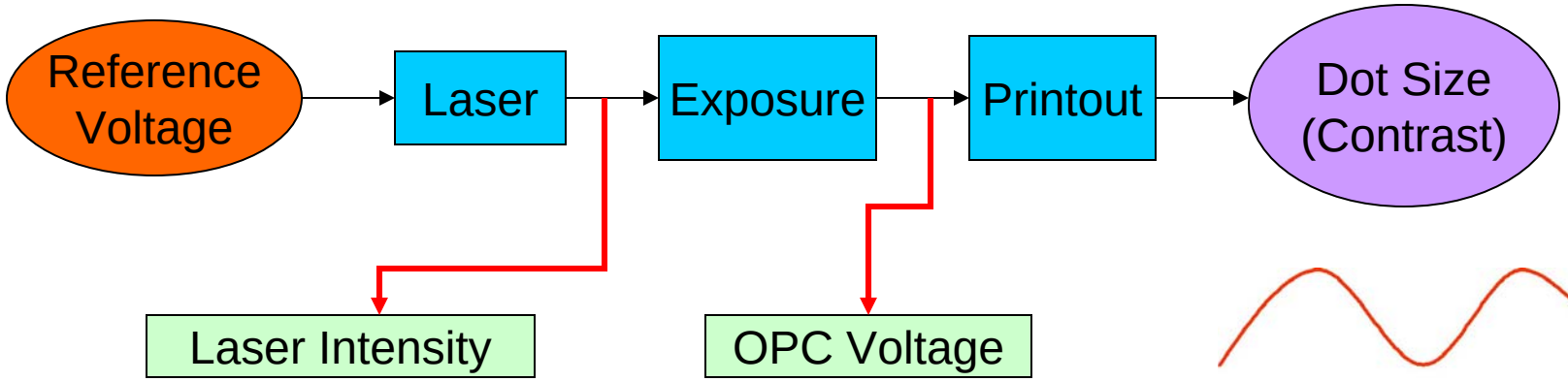
- **Printer identification by extraction of intrinsic features**
- **Electromechanical imperfections and fluctuations cause print quality defects which can be treated as a signature of the printer**

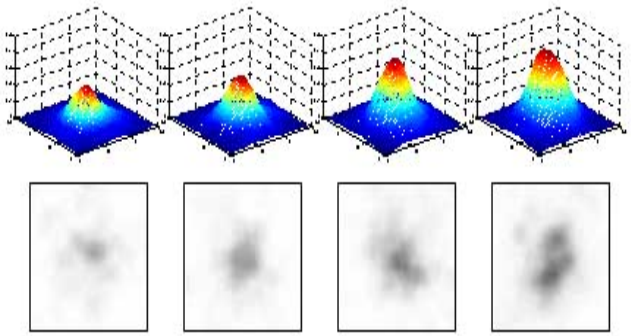


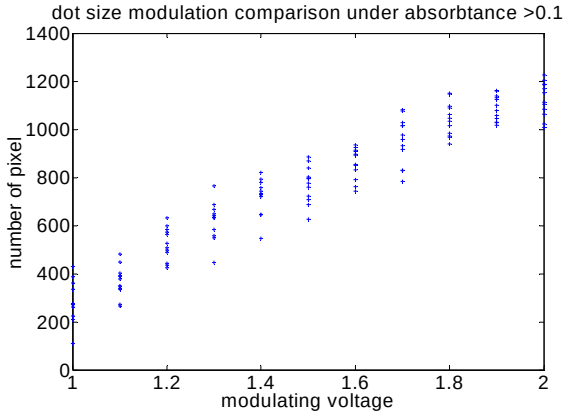
Electrophotography (EP)



Extrinsic Signature Embedding – Laser Exposure Modulation

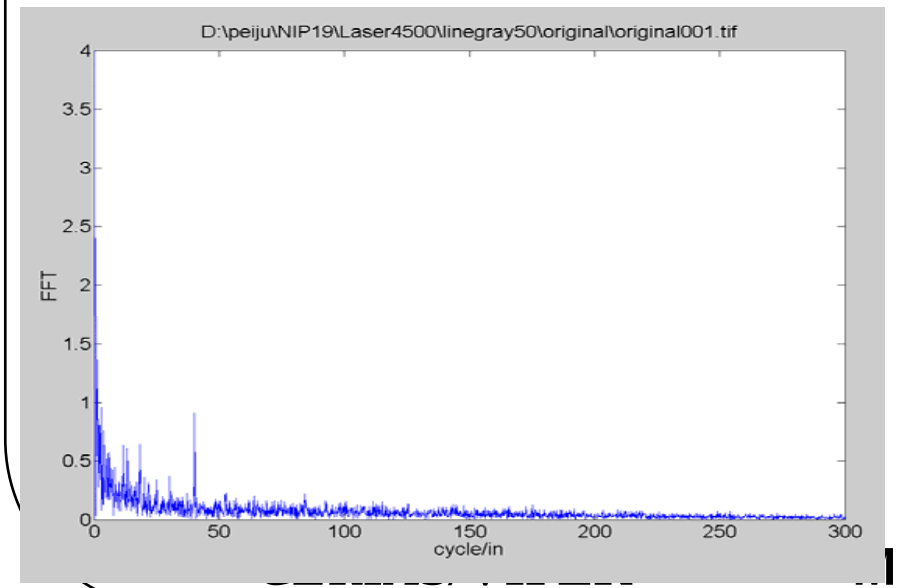


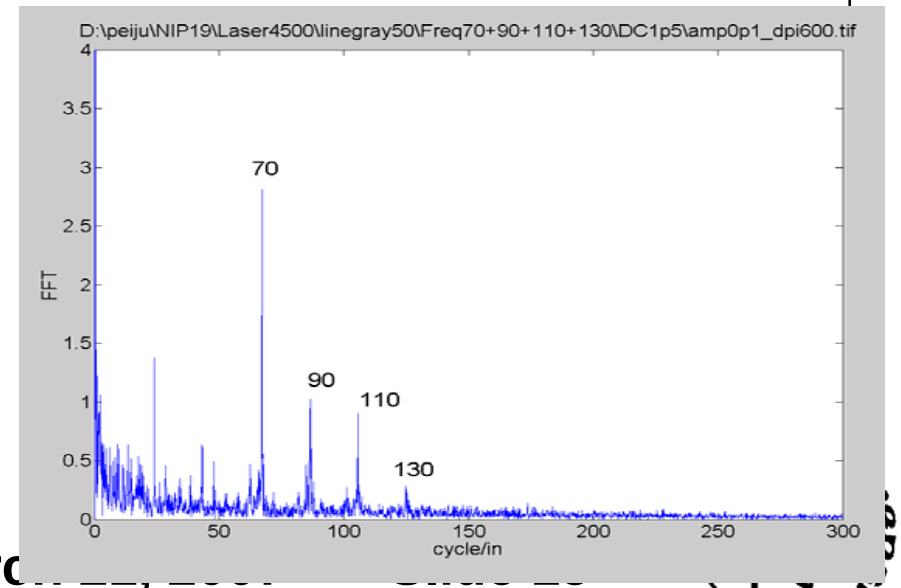




Periodic Signal

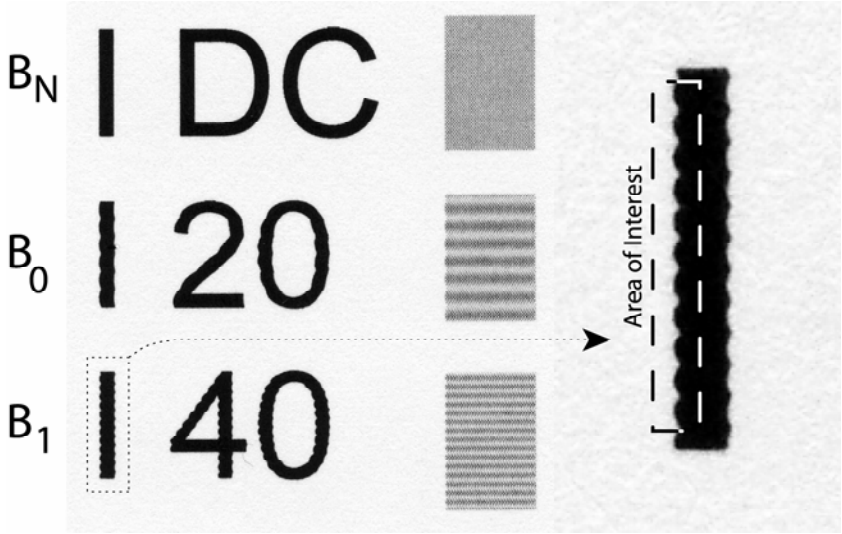
Extrinsic Signature Embedding



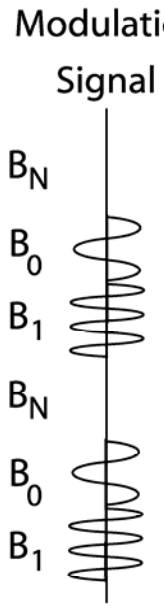


Effects of Laser Modulation

- ***Artificial banding*** **in midtone regions**
  - **– Can be minimized by designing the modulation signal to lie below the human contrast sensitivity curve**
- **Edge raggedness visible on vertical edges**
  - **– Can be minimized by limiting embedding amplitude**
  - **– Can also be used to detect the signals! Use ISO-13660 raggedness measure**



Embedding Framework



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Final Comments

- **Federal Courts in US have accepted these methods, particularly for cameras**
- **Privacy - the device essentially "spies" on its user**
  - **– we are investigating methods to "turn off" the signature**