Steganography and Digital Image Forensics

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MATH/CprE/CybSc 535

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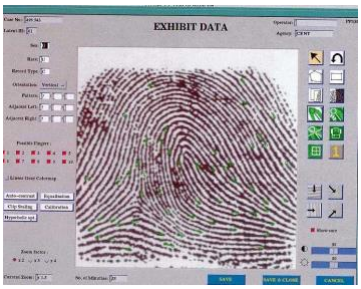
SYLLABUS



Assignments and Grading 5 Programming assignments: 70% Online Discussions: 10% Final Project 20% (no final exam)	**Required Textbook:** None. Reading will be assigned from free sources available on the internet and from ISU's library.

Free Expression statement

CLASS STRUCTURE:

Lecture content	Lecture sessions are pre-taped and available on Canvas as a video only
Homework Assignments	Coding assignments in Python or Matlab Assignments may include problems requiring written exposition of concepts
Discussions Questions	3-5 problems assigned to discussion groups on Canvas
Final Project	A project with a topic of your choice, agreed through mutual discussion with Dr. Newman. A 10-15 page paper is required in addition to a **15-minute presentation to class during Prep Week (last week of classes)**
Office Hours	Live office hours on WebEx

Other Reference Material (not required to purchase)
(Print only): Jessica Fridrich, 2009. *Steganography in digital media: principles, algorithms, and applications*. Cambridge University Press.

Available as ebooks online at the ISU library, required reading from parts:

- Advanced Statistical Steganalysis by R. Böhme. 2010.
- Schaathun, Hans Georg. *Machine learning in image steganalysis*. Wiley, 2012.
- Sencar, Husrev Taha, and Nasir Memon, eds. *Digital Image Forensics: There is More to a Picture than Meets the Eye*. Springer Science & Business Media, 2012.

Online Discussions: Each student is assigned to participate in discussions on the Canvas discussion board. More information will be made available in class lectures.

Homeworks. Homeworks consist of a programming component and a written exposition component. All written expositions for homeworks **must be in pdf** and must be submitted through the Canvas website. Your choice of coding language must stay constant throughout the semester. Homeworks may also contain questions that are conceptual in nature and will require answers to be hand-written or composed in LaTeX or Word.

Reading: posted on Canvas.

Notes:

1. If you have need of a disability accommodation, please contact me during the first week of classes, or immediately otherwise if your situation changes in the semester.
2. You are responsible for being aware of announcements on Canvas.
3. The Department and University policies will be followed. See here for a complete description. This includes make up assignments, electronic devices, and Prep Week assignments.
4. Plagiarism is a serious offense and any offense of this type of academic misconduct will be reported to the Dean of Students and Judicial Affairs offices. Consult here or ask Dr. Newman if you have any doubts about what constitutes plagiarism.

Objectives of the course: A student finishing this course should have a firm grasp of the topics listed below; should be able to solve basic image forensic problems and create programs using MATLAB or Python code; and should have an understanding of the technical components of the processing for image forensic analysis.

MATH 535 TOPICS

Overview of digital image forensics

Image acquisition, formats, and modeling of such processes
Image datasets
Steganography and steganalysis
Camera identification
Image forgery and counterattacks
Image forensics and the law

Creating digital images: the image acquisition process/camera pipeline

Optics, sensors, on-device processing; turning photons into a digital image; contributors to image artifacts; CMOS vs CCD sensors;
Noise: thermal and circuitry noise, stochastic noise, photo response non uniformity (PRNU), fixed pattern noise (FPN), read noise
The image pipeline: on-chip image processing, color filter arrays (CFA), noise reduction, demosaicing, gamma correction, white balancing, color space conversion (Y′CbCr), compression and storage, EXIF, JPEG, RAW, TIFF image formats

Basic image processing techniques

Chosen from: resolution determination; color representation and effects; histogram manipulation; frequency analysis; contrast processing; image rectification; linear interpolation techniques; common transforms including the Discrete Cosine Transform; filtering techniques; image formats; noise in images; perspective geometry; physics of lighting.
Machine learning and optimization techniques for imaging problems.

Steganography and steganalysis: hiding, detecting a message in an image; real-world use of stego apps

Camera device identification and camera model identification

Source identification of image data; using PRNU to identify the sensor of an image.

Creating forgeries using digital images

Different types of image tampering/forgery: copy-and-paste, splicing, computer-generated.

Detection of forgeries - basic forensics methods

Optics, format-based, geometric, chromatic, statistical, pixel-based, CFA and demosaicing, camera response function and CRF, PRNU, machine learning and features, JPEG, chromatic aberrations

Image forensics in the courtroom