This project focuses on creating a higher quality method of fingerprinting that reveals more visible minutiae.

**Problem**

Issues with current fingerprinting methods

- Traditional fluorescent dyes and powders: expensive, difficult to synthesize, and aren’t environmentally friendly
- Small range of florescence so multiple powders are needed for different surfaces increasing variability and room for error.

Currently 22 known instances of incorrect court rulings based on fingerprint evidence and studies suggest there could be thousands more (abcnews.go.com).

**Background**

- **Carbon dots** are a carbon-based nanomaterial which are fluorescent and have a low toxicity, making them a good candidate for fingerprinting
- **Cyanoacrylate fuming** is one of many used methods of fingerprint analysis which involves using a cyanoacrylate glue to fume fingerprints
  - 1 step: fluorescent dye/powder applied before fuming
  - 2 step: fluorescent dye/powder applied after fuming
- **Minutiae** - characteristics of fingerprints used to compare and classify fingerprints

**Goals**

- Research Question
  - How can using carbon dots in conjunction with cyanoacrylate fuming create higher quality latent fingerprints?

**Engineering Goals**

1. Create prints that fluoresce under 625nm, 530nm, and 465nm
2. Create prints with at least 5 more minutiae on average than just cyanoacrylate prints
3. Create prints with at least 5 more minutiae on average than just carbon dot dusted prints
Methods

Collect Control 1 Prints
Collect Control 2 Prints
Collect Experimental Prints
Collect Photos of Prints
Analyze under FPMV software & Perform T-Test

Variables

Control Group 1
Cyanoacrylate fuming followed by a fluorescent dye treatment (CyanoBlue spray)

Control Group 2
Only dusting with carbon dot powder

Experimetal Group
Carbon dot powder dusted on followed by cyanoacrylate fuming

Fingerprint Collection

All photos of me & my prints

Data Processing

FPMV software used to analyze fingerprints. Converted images into grayscale for more accurate results.

Number of Minutiae

01
Changed to only show minutiae with a quality of 0.2

02
NFIQ Score
1 – highest score
5 – lowest score (unusable prints)

Data

Control Group 1
Control Group 2
Experimental Group

Data tables all created in Excel

Data Analysis

01
T-Test: Compares variance between groups
No unequal variance

02
T-Test: Two sample with unequal variance
Compares the average number of minutiae between groups

Graphics & data tables all created in Excel
**Conclusion**

P-Value = 0.0026 Between Control Group 1 and Experimental Group. 52 more minutiae on average.

**Discussion**

- Between control Group 2 & the Experimental Group the novel procedure still produced more than 13 visible minutiae on average exceeding my engineering goal of 5 or more visible minutiae.
- 39.5 more visible minutiae on average between Control Group 1 vs 2.
- The NFIQ score for my novel prints was higher on average than both control groups.
  - Higher under red and blue light when compared to Control Group 2.
- Image of my fingerprint under FFMV software.

**Limitations**

- Camera quality & angle of photo
- Pressure of fingerprint deposit
- Substances available to test (couldn’t test tunability) & amount of carbon dots limited
  - limited materials carbon dots were tested on

**Future Application**

- Test under a wider range of wavelengths using a fluorescent microscope
  - Test between wavelengths of 450-650 nm
- Apply on a larger scale among forensic scientists
  - Reach out to Washington State crime lab
- Test fluorescence tunability
  - Coat fingerprints in different substances and test for patterns in quantum yield of fluorescence
- Run through AFIS program
  - Automated Fingerprint Identification System

**References**


- Image of carbon-dot capabilities created based on graphics from (Liu and Yang 2020) and (Khalifeh, Panja, Nandini 2021).