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Sequencing Strokes in a Crossed-Line Intersection Using Ultraviolet-Visible Microspectrophotometry

Determining the age of a document is essential to a forensic document examiner, but an equally important focus area is the sequence of intersecting lines, which is instrumental in determining authenticity. However, past techniques that have been used for sequencing, both physical and chemical, are not consistently effective and some analyses are destructive towards the evidence. In a recent INTERPOL and AIEED study, the migration distance of a non-visible component of pen ink was used to determine the age of a crossed-line intersection. These components were visualized through luminescence when viewed under alternate light sources. Development of a non-destructive method to sequence two markings in a crossed-line intersection is desirable and a UV-visible microspectrophotometer (UV-Vis MSP) can be used for this purpose through the collection and comparison of fluorescent spectra. This study is based on the hypothesis that the pen that is on top in the intersection will emit greater fluorescence than the pen on the bottom. Specifically, when the intersection spectrum is compared to control spectra, the control for the pen on top should share more peaks with the intersection than the pen on the bottom. These fluorescent spectra are measured in reflectance, which is why the pen on top will fluoresce more and have more shared peaks. However, the bottom pen also shares peaks due to small amounts of penetration. This study examined the fluorescent data from intersection samples, which had been stored in heat and humid environments, to the control samples, which were stored in an ambient environment. The results of this study show that different environments produced varying success of the sequencing.

References:

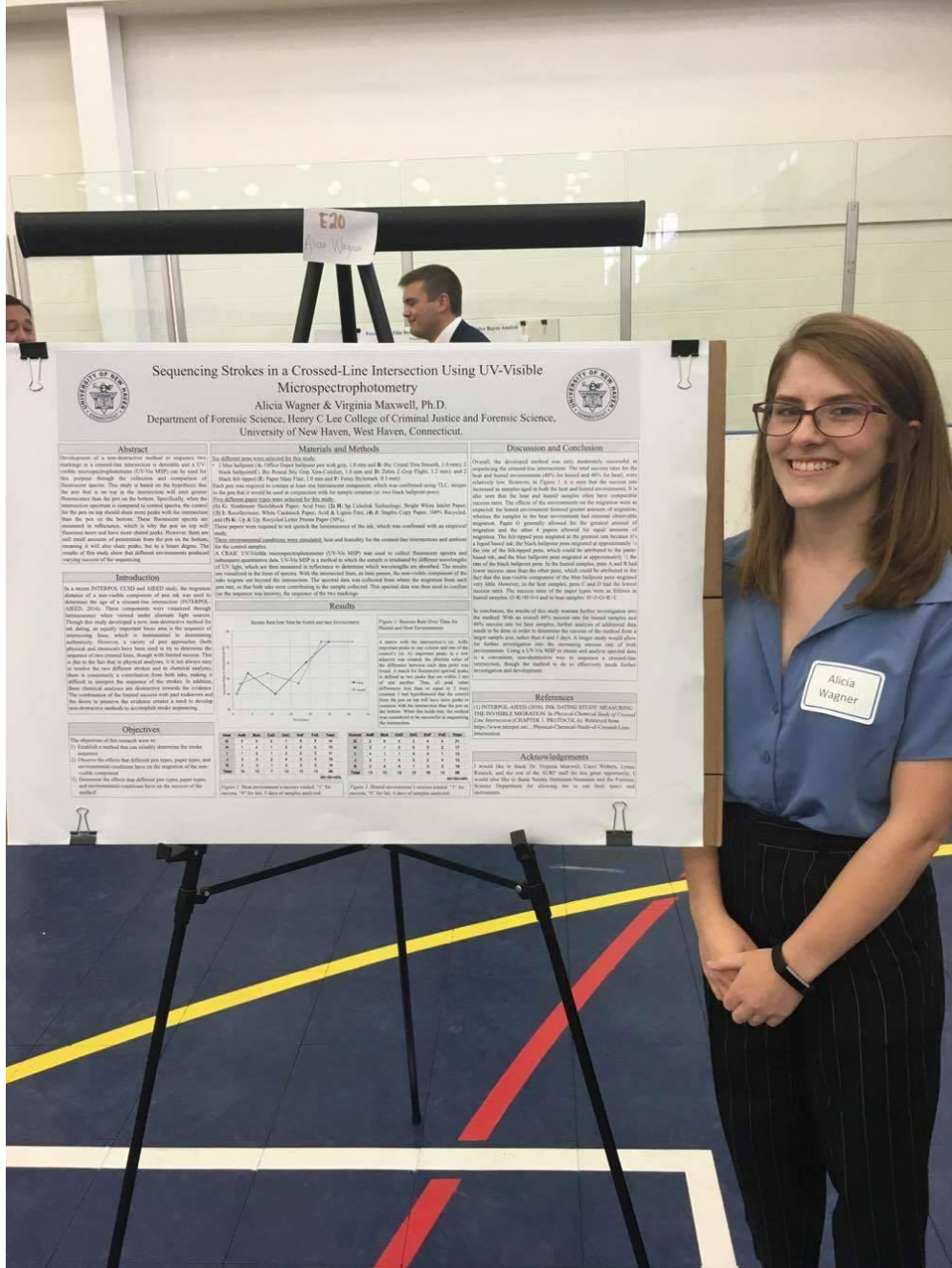
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Bio:

Hello, my name is Alicia and I am from Newburgh, New York. I am a junior majoring in Forensic Science with a concentration in Chemistry, and I plan on pursuing a Masters, or possibly a doctorate, in Chemistry. On campus, I am a member of the Paranormal Research and Investigation Organization and the Forensic Science Student Association, where I am a committee head of the Community Service Committee.



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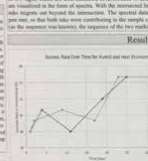
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Abstract
Development of a new microspectroscopy method to sequence two strokes in a crossed line intersection and a UV-visible microspectrophotometry (UV-Vis MFP) can be used for this purpose through the collection and comparison of fluorescence spectra. The goal of this research was to determine the sequence of strokes in a crossed line intersection. The UV-Vis MFP was used to collect fluorescence data from the pen on the bottom. Specifically, when the intersection sequence is oriented to reveal the bottom pen stroke, the pen on top will fluoresce more than the pen on the bottom. These fluorescence spectra are compared to reference spectra to determine the sequence of the intersection.

Introduction
In a recent INTERPOL, IAFIS and FBI study, the sequencing of a cross-line intersection (INTERPOL, IAFIS, FBI, 2016). This research was conducted through the use of a UV-Vis MFP. The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection. The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection. The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection.

Objectives
The objectives of this research were to:
1) Establish a method that can reliably determine the stroke sequence.
2) Determine the effects that different pen types, paper types, and intersection conditions have on the sequence of strokes.
3) Determine the effects that different pen types, paper types, and intersection conditions have on the sequence of strokes.

Materials and Methods
The different pens were selected for this study. The pens selected for this study were: 1) Blue ballpoint pen (Pilot G-7), 2) Blue ballpoint pen (Pilot G-7), 3) Blue ballpoint pen (Pilot G-7), 4) Blue ballpoint pen (Pilot G-7), 5) Blue ballpoint pen (Pilot G-7), 6) Blue ballpoint pen (Pilot G-7), 7) Blue ballpoint pen (Pilot G-7), 8) Blue ballpoint pen (Pilot G-7), 9) Blue ballpoint pen (Pilot G-7), 10) Blue ballpoint pen (Pilot G-7).



Stroke	Pen	Fluorescence
1	Blue ballpoint pen (Pilot G-7)	0.15
2	Blue ballpoint pen (Pilot G-7)	0.15
3	Blue ballpoint pen (Pilot G-7)	0.15
4	Blue ballpoint pen (Pilot G-7)	0.15
5	Blue ballpoint pen (Pilot G-7)	0.15
6	Blue ballpoint pen (Pilot G-7)	0.15
7	Blue ballpoint pen (Pilot G-7)	0.15
8	Blue ballpoint pen (Pilot G-7)	0.15
9	Blue ballpoint pen (Pilot G-7)	0.15
10	Blue ballpoint pen (Pilot G-7)	0.15

Results
The results of the UV-Vis MFP are shown in the graph. The graph shows that the bottom pen stroke fluoresces more than the top pen stroke. This indicates that the bottom pen stroke was written first. The results of the UV-Vis MFP are shown in the graph.

Discussion and Conclusion
The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection. The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection. The UV-Vis MFP is a non-destructive method that can be used to sequence strokes in a crossed line intersection.

References
1) INTERPOL, IAFIS, FBI, 2016. The sequencing of a cross-line intersection. <https://www.interpol.int/Newsroom/Press-Releases/2016/09/01/Sequencing-a-Crossed-Line-Intersection>.

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