Chris Tanguay and Chris McGrath are undergraduate students in the Bachelor of Science in Computer Security and Information Assurance (BSCSIA) program at Norwich University <http://www.norwich.edu/academics/business/informationassurance.html> are currently taking the CJ341 course on cybercrime and cyberlaw <http://www.mekabay.com/courses/academic/norwich/cj341/index.htm>. Recently they went down the road to Dartmouth College to attend a lecture that will interest readers of this column; here is their trip report (and they both got extra points on their class grade).

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Digital image forgery is a growing problem in criminal cases <http://expertdocumentexaminer.com/forgery/forgerycases/> and in public discourse. Photographic fakes can be used to promote a magazine story, defame a political opponent, or other objectives.<http://www.cs.dartmouth.edu/farid/research/digitaltampering/> Digital image forensic tools are helping to investigate and solve crimes. The development of these tools is essential to the future of forensic analysis of digital images.<http://www.cnet.com.au/software/imaging/0,239035345,240060103,00.htm>

At Dartmouth College, New Hampshire, Micah Kimo Johnson presented his computer science doctoral thesis proposal on 6 October 2006. The topic was “Lighting and Optical Tools for Digital Image Forensics.” These tools are capable of detecting traces of tampering in digital images without depending on watermarks or specialized hardware.

Since camera companies have not yet imposed digital watermarks on photographs, how can anyone be sure that photos have not been modified? The question is particularly important for crime-scene photos that may be offered as evidence in court.

Mr Johnson presented three new digital image forensic analytical tools: illuminant direction, specularity, and chromatic aberration.

Illumination direction analyzes the light sources in photographs. The tool looks for consistent light sources throughout the whole image. He has created a mathematical approach to calculating the angle of the incident light based on the shadows in the picture. If light sources were not in the same direction the tool can pick up the discrepancies. The tool works not only with sunlight but also works with local sources such as lamps. The analytical software has been built and tested with excellent results; he is now working on a user interface so that others will be able to use it.

His specularity tool looks at specular (reflective) highlights in images. In his presentation, he displayed a picture of the cast from “American Idol” in which two of the characters were added to the picture after the photo was taken. He showed that the glossy or reflective parts in the photo (e.g., eyes, glasses) had one light source in the reflection of the eyes of some characters but two sources in the eyes of others. He is still working on the program and the mathematical algorithm.
The chromatic aberration tool works on the principles of a camera lens and Snell’s law.<http://scienceworld.wolfram.com/physics/SnellsLaw.html> Any lens produces a natural distortion in the photo that can be mapped across the surface of the original picture. If the distortion in part of a picture does not match the distortion around it, the picture has been modified; e.g., there may be superposition of material from a different photo. He is still working on the development of this tool to improve performance.

Mr Johnson’s research adds to existing image forensic tools developed in the lab at Dartmouth where he works with his advisor Dr Hany Farid. <http://www.cs.dartmouth.edu/farid/research/tampering.html> These contributions will significantly advance the field of forensic analysis of digital images. Individually, these tools can’t be applied to every photo, but combining them together with other forensic tools will greatly help in investigations and verifications of forged images. Although these tools will not detect every forged or modified photo, but they will make forgery a great deal more difficult to circumvent expert analysis.

For more about Kimo Johnson’s research on digital forensics, visit his Website at <http://www.cs.dartmouth.edu/~kimo/research/image_forensics/index.html>.

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