

I am 45 years old, an avid cyclist, a Professor of Computer Science at Dartmouth, and according to some, complicit in the conspiracy to assassinate United States President John F. Kennedy.

Ever since the assassination of President Kennedy, numerous theories have circulated claiming that Lee Harvey Oswald, the accused assassin, acted as part of a larger criminal conspiracy.<sup>1</sup> It has been suggested, for example, that incriminating photographs of Oswald were manipulated, and hence evidence of a broader plot. The argument goes something like this. Consider the shadow cast from Oswald's body onto the ground. The orientation and length of the shadow suggest that the sun is to Oswald's left and relatively low on the horizon. The long straight shadow under Oswald's nose, however, suggests that the sun is directly above him. These seemingly incongruous shadows have led to speculation that Oswald's head was pasted into the scene. In fact, Oswald himself claimed that the photo was a fake and had been altered to falsely implicate him.



During my 2006-2007 Guggenheim Fellowship, I began to explore mathematical and computational techniques for reconstructing lighting, shadows, and geometry from a single image. This work was part of my larger research in digital forensics in which I have developed technology to analyze, enhance, and authenticate digital media. As my fellowship year came to an end, I had completed the basic framework for a forensic analysis that would allow me to determine if the shadows in a photo were physically plausible or not.



I had never been particularly interested in the conspiracy theories regarding the assassination of President Kennedy. I did, however, like that at least one aspect of the theory was testable – were the shadows in the Oswald backyard photo physically plausible or not? And I, perhaps naively, thought that the larger community would welcome some quantitative and definitive evidence either supporting or contradicting this assertion.

I thought that there was a chance that the photo was fake because it did seem at first glance that the shadows in this photo were inconsistent with one another. I also knew, however, that our visual system can be spectacularly bad and judging such things as lighting and shadows in a photo<sup>2</sup> (which, after all, is a mere two-dimensional representation of a far richer three-dimensional scene).

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<sup>1</sup> These conspiracy theories are not just the province of a small minority; a 2003 ABC News poll found that 70% of Americans believe that Kennedy's death was the result of a broader plot.

<sup>2</sup> H. Farid and M.J. Bravo. *Image Forensic Analyses that Elude the Human Visual System*. *SPIE Symposium on Electronic Imaging*, San Jose, CA, 2010.

After I completed my forensic analysis, I published my findings along with the supporting evidence that showed that the lighting and shadows in the Oswald backyard photo were perfectly consistent with the physical scene.<sup>3</sup> Over the next several months I fielded a barrage of angry emails, letters, and phone calls (and one very troubled visitor to my office). These correspondences informed me of my incompetence and/or complacency with the CIA, FBI, Cubans, and/or Russians in the continued cover-up of the assassination of President Kennedy. Among my favorite correspondences was a polite letter informing me that the writer had incontrovertible proof that Oswald was photographed with a Nikon digital camera and that the photo was altered using Adobe Photoshop which, as I was informed, was possible due to the existence of a time portal in which this equipment was sent back in time (a second time portal, I also learned, was used to install the Photoshop license). A particularly virulent group called on the Dartmouth Board of Trustees, President, Provost, and Dean of Faculty to have me investigated and stripped of my tenure (although I was asked by the Dean about my relationship with the CIA, my tenure was not revoked).

Most recently I was asked by countless organizations and media outlets to perform a forensic analysis of President Obama's birth certificate. Having learned that facts have no place in a good conspiracy, I demurred.

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<sup>3</sup> H. Farid. The Lee Harvey Oswald Backyard Photos: Real or Fake? *Perception*, 38(11):1731-1734, 2009.