Novel Light-Field Messaging Captured in a Camera

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**Invention Summary:**

Light Field Messaging (LFM) is a process of embedding, transmitting, and receiving hidden information in video that is displayed on a screen and captured by a handheld camera. The goal of the system is to minimize perceived visual artifacts of the message embedding, while simultaneously maximizing the accuracy of message recovery on the camera side. LFM requires photographic steganography for embedding messages that can be displayed on a screen and captured by a camera. Unlike digital steganography, the embedding requirements are significantly more challenging due to the combined effect of the screens’ diverse radiometric emittance functions, the cameras’ variable sensitivity functions, and the camera-display relative geometry.

Scientists at Rutgers have devised and trained an AI network to jointly learn a deep embedding and recovery algorithm that requires no multi-frame synchronization. A key novel component is the camera display transfer function (CDTF) to model the camera-display pipeline. The result of this novel work is a high-performance real-time LFM system using consumer-grade displays and smartphone cameras.

**Advantages:**

- Invisible to humans.
- Robust to diverse camera and display hardware combinations.
- No temporal synchronization required.
- Accurate message transmission and recovery.
- Better bit-error-rate than existing deep-learning and fixed-filter steganography approaches.

**Market Applications:**

1) Anti-piracy water-marking.

2) Imperceptible messaging for consumer engagement and increased purchases.
Inventors

Eric Wangrowski, PhD

Dr. Eric Wangrowski is a Computer Vision and Machine Learning entrepreneur and the founder and CEO of Steg AI. He has a PhD in the Electrical & Computer Engineering from Rutgers University. His research advisor was Professor Kristin J. Dana. His research interests include photographic steganography, computational photography & imaging, and deep learning.

Kristin Dana, Ph.D.

Dr. Kristin Dana, is a professor in the Department of Electrical and Computer Engineering at Rutgers, The State University of New Jersey. Her research is in computer vision, pattern recognition, machine learning, optics and computer graphics. She is the inventor of the "texture camera" for convenient measurement of reflectance and texture. Dr. Dana is also a member of Rutgers Center for Cognitive Science, a member of Graduate Faculty of the Computer Science Department, and an adjunct assistant professor of medicine at UMDNJ, Robert Wood Johnson Medical School. Dr. Dana received the PhD from Columbia University (NY,NY) in 1999 and the MS degree from Massachusetts Institute of Technology in 1992, and a BS degree in 1990 from the Cooper Union (NY,NY). From 1992-1995 she was on the research staff at Sarnoff Corporation developing real-time motion estimation algorithms for applications in defense, biomedicine and entertainment industries. She is the recipient of the General Electric "Faculty of the Future" fellowship in 1990, the Sarnoff Corporation Technical Achievement Award in 1994 for the development of a practical algorithm for the real-time alignment of visible and infrared video images, and the 2001 National Science Foundation Career Award for a program investigating surface science for vision and graphics.