A Configurable Single-Axis, Multi-Parameter Lens Camera

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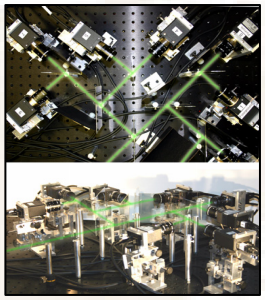
SAMPL passively replicates an incident light field with an optical tree of half-mirror beam splitters. This allows multiple video sensors to share an optical center. At each sensor, we vary the imaging parameters like frequency response, aperture, image plane depth, and exposure time. This enables data capture for many applications using a single reconfigurable device. Many previous systems (e.g., [1, 2]) use a small number of single-axis sensors for a specific application. We believe SAMPL is the first to support eight sensors and the notion of reconfiguration.

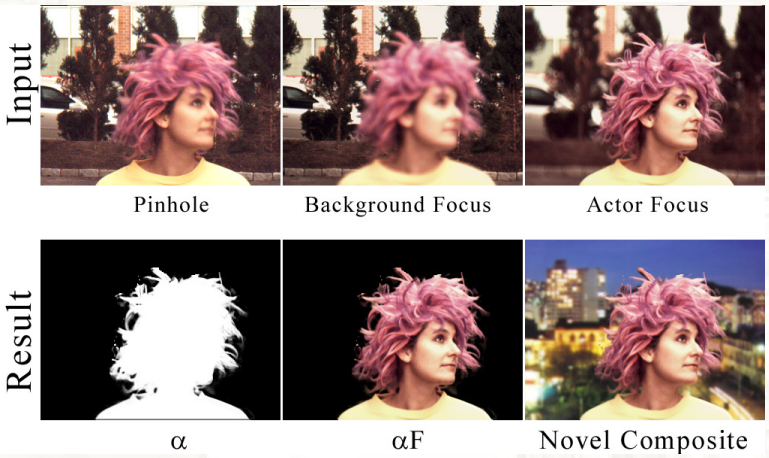


The figure on the right shows top and side views of the splitting tree. The optical path is drawn in green.

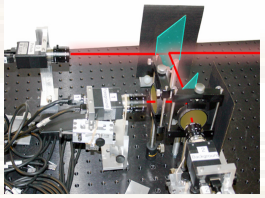
Each path terminates at a Basler a601fc camera. Using three FireWire cards, SAMPL captures 640 × 480 × 8 × 30fps Bayer video on a single PC.

SAMPL is built on a small optical breadboard bolted to the top shelf of a cart. The center shelf holds a keyboard and monitor and the lowest a PC and battery packs for two hours of operation on-location.

SAMPL also captured multiview video for the MPEG multiview working group with a boom arm, as reported in **Multiview Video Test Sequences from MERL. Vetro, McGuire, Matusik, Behrens, Lee, and Pfister. Korea 2005.** Although these sensors have different axes, the capture and calibration processes are unchanged.



Defocus Video Matting. McGuire, Matusik, Pfister, Hughes, and Durand. SIGGRAPH 2005.

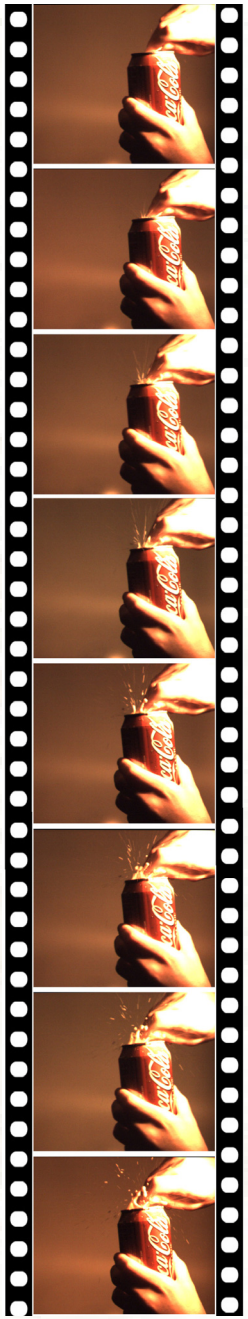


For matting, we configure SAMPL with three differently-focussed sensors. In the figure, the top-left sensor has a "pinhole" f/16 aperture, and the other two have f/1.4 apertures and neutral density filters (brown) to compensate for the increased light. One of the f/1.4 sensors is focussed on the background and one on the actor. An optimizer solves for the foreground, background, and matte images that give rise to the different images captured.

The figure on the right shows consecutive frames of 240 fps high speed video of a soda can opening. These were captured by staggering the frame times in the full 8-camera tree. We have also successfully captured multi-modal, HDR, multi-focus, and hybrid high-speed multi-modal video streams.

[1] Aggarwal and Ahuja, Split Aperture Imaging for High Dynamic Range, ICCV 2001

[2] Favaro and Soatto, Seeing Beyond Occlusions, CVPR 2003



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