NASA SBIR/STTR Technologies

Holographic Waveguided See-through Display (HoWSD)

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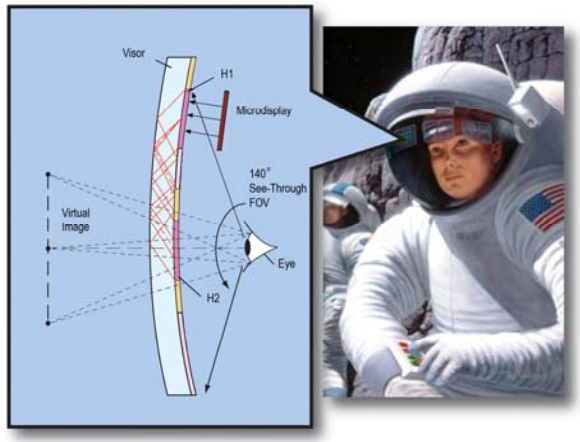
Technical Objective

To address the NASA need for lightweight, space suit-mounted displays by demonstrating the feasibility of a Holographic Waveguided See-through Display (HoWSD). The HoWSD should provide NASA with a minimally invasive and unobtrusive helmet-mounted display with easy-to-access clearly visible information to the astronaut during extravehicular activity (EVA). HoWSD should represent a low-profile lightweight, fully see-through, wide field-of-view, high resolution system.

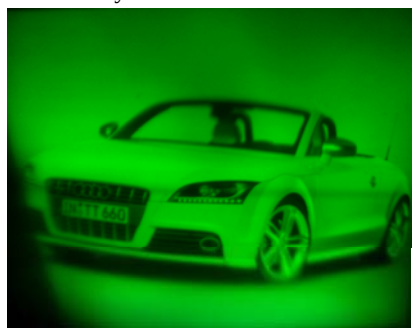
Approach

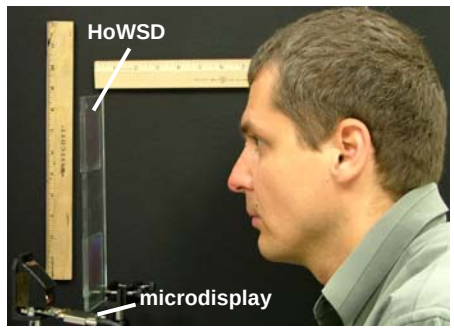
Design of highly efficient waveguiding holograms, hologram integration onto a thin transparent see-through visor, optical coupling of the visor with a bright miniature display Source.



Phase I Accomplishments

- Completed a preliminary design analysis and designed a proof-of-concept HoWSD
- Determined the optimal parameters for HoWSD components, including holograms and display source, to achieve the specified system performance
- Investigated stat-of-the-art micro-display technologies including transmissive and reflective LCDs, color and monochrome OLEDs
- Identified and acquired HoWSD components, including the display source, holographic material, and substrate
- Assembled a proof-of-concept HoWSD consisting of a display source, a wave-guiding plate, and coupled holographic elements
- Tested the proof-of-concept HoWSD and demonstrated the specified Phase I system performance factors: see-through capability, 23^0-25^0 field-of-view, and more than 70 mm eye relief





Phase II Plan

- Optimization and refinement of the HoWSD system design, including SXGA microdisplay, coupling optics, and two holograms
- Optimization of the hologram design, and development of a two-hologram recording system (including curved substrate) to improve geometrical compactness and diffraction efficiency, reduce aberrations, and meet the requirements for eye relief, brightness, monochrome and color grayscale
- Development of a high-resolution, high-brightness microdisplay image projection subsystem for a two-hologram waveguide visor plate on a curved substrate that can achieve low image distortion, high light efficiency and uniformity, with a target field-of-view of 40^0
- Integration of a prototype HoWSD system that accounts for the parameters of the EVA space suit, and evaluation of this prototype's performance as an advanced waveguided head-mounted display system

NASA and Non-NASA Applications

See-through display integrated into space suit helmet for astronaut EVAs.
Real time information displays for medical and emergency response personnel, avionic and automotive systems, education, training, and gaming systems.

Firm Contacts

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NON-PROPRIETARY DATA