The Hyerspectral Imager-Tracker (HIT) is a technique for visualization and tracking of low-contrast, fast-moving objects. The HIT architecture is based on an innovative and only recently developed concept in imaging optics. This innovative architecture will give the Light Prescriptions Innovators (LPI) HIT the possibility of simultaneously collecting the spectral band images (hyperspectral cube), IR images, and to operate with high-light-gathering power and high magnification for multiple fast-moving objects. Adaptive Spectral Filtering algorithms will efficiently increase the contrast of low-contrast scenes.

The most hazardous parts of a space mission are the first stage of a launch and the last 10 kilometers of the landing trajectory. In general, a close watch on spacecraft operation is required at distances up to 70 km. Tracking at such distances is usually associated with the use of radar, but its milliradian angular resolution translates to 100-m spatial resolution at 70-km distance. With sufficient power, radar can track a spacecraft as a whole object, but will not provide detail in the case of an accident, particularly for small debris in the one-meter range, which can only be achieved optically. It will be important to track the debris, which could disintegrate further into more debris, all the way to the ground. Such fragmentation could cause ballistic predictions, based on observations using high-resolution but narrow-field optics for only the first few seconds of the event, to be inaccurate. No optical imager architecture exists to satisfy NASA requirements.

The HIT was developed for space vehicle tracking, in-flight inspection, and in the case of an accident, a detailed recording of the event. The system is a combination of five subsystems: (1) a “roving fovea” telescope with a wide 30° field of regard; (2) narrow, high-resolution “fovea” field optics; (3) a “Coude” optics system for telescope output beam stabilization; (4) a hyperspectral-multiplexed imaging assembly; and (5) image analysis software with effective adaptive spectral filtering algorithm for real-time contrast enhancement.

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