THE THERMAL-CAMERA FOR EXPLORATION, SCIENCE, AND IMAGING SPACECRAFT (THESIS) FOR THE PROX-1 MICROSAT MISSION M. S. Veto[1], P. R. Christensen[1], and D.A. Spencer[2]. [1]Arizona State University (Mars Space Flight Facility, 201 E. Orange Mall, Tempe, AZ 85287; mveto@asu.edu, phil.christensen@asu.edu) [2]Georgia Institute of Technology, (School of Aerospace Engineering, Atlanta, GA 30332-0150; david.spencer@aerospace.gatech.edu)

Background: THESIS is an instrument system consisting of an Infrared Camera, a Visible Camera, and an Instrument Computer to be integrated as a payload element for the *Prox-1* microsatellite mission. The mission is collaboration in which students of PI David Spencer (*Mars Odyssey* Mission Manager) and Phil Christensen (THEMIS PI) have been working together to design, build, integrate, and test a Microsatellite-class spacecraft (10-100 kg) for the Univerisity Nanosatellite Program (UNP) sponsored by the Air Force Office of Scientific Research/Air Force Research Laboratory. In this program students compete against other universities and must demonstrate over a 2 year period of several reviews that the mission fits within the goals of the the customer (AFRL), that sufficient engineering analysis has been conducted through detailed documentation subsystem reports, and that progress can be shown on the development of flight hardware. *Prox-1* was selected as the winner of the UNP-7 microsatellite competition in 2012.

***Prox-1* Mission and Spacecraft:** *The Georgia Institute of Technology Prox-1 mission will demonstrate automated trajectory control in low-Earth orbit relative to the deployed LightSail-B CubeSat for an on-orbit inspection application* [2]. To achieve this, the *Prox-1* spacecraft—equiavelent to a 75U cubesat—has been designed, built, integrated, and tested at the Space System Design Lab at the Georgia Institute of Technology under PI David Spencer. The primary objectives of the mision are to 1) flight qualify new technologies including THESIS, a microsatellite control moment gyroscope unit, and a 3-D printed propulsion system 2) deploy the Planetary Society's *LightSail-B* CubeSat, and 3) test on-board guidance algorithms for implementing automated trajectory control for proximity operations [2]. *Prox-1* is planned to launch on the SpaceX *Falcon Heavy* launch vehicle in 2017, and will carry the Planetary Society's *LightSail-B* as a payload within an integrated P-POD deployment system.

THESIS Instrument Suite Overview: The THESIS instrument suite consists of an infrared camera, a visible camera, and an instrument computer. It is designed, built, and tested at the class 100K clean room facilities at Arizona State University by integrating COTS and custom components into an instrument system. The architecture of the THESIS instrument system is inspired by THEMIS and uses instrument science calibration practices developed for THEMIS [3] while engineering expertise and advisement is lent by the OTES Engineering Team.

THESIS Goals*:* The three goals of the THESIS instrument system are to support *Prox-1* as follows:

1) Verify LightSail-B Deployment

After *Prox-1* deploys the Planetary Society's *LightSail-B* from the P-POD, the THESIS instruments will capture images of LightSail-B that will be downlinked to show its ejection. *Prox-1*-THESIS will also capture visible and infrared images of the solar sail deployment of the *LightSail-B.* While *LightSail-A* successfully deployed its sails and captured a self-image, *Prox-1*-THESIS will capture a third-perspective images of a solar sail deployment in space for the first time.

2) Demonstrate Proximity Operations

The THESIS instruments will also capture IR images that will be used in conjunction with image processing algorithms to determine the relative range and range-rate of *LightSail-B* with respect to *Prox-1*. The resulting relative orbit determination will be used to conduct automated proximity operations [2,4].

3) Conduct Earth Remote Sensing

Finally, should all the mission objective be accomplished, THESIS will be able to support visible and infrared remote sensing of Earth in order to provide opportunities for scientist to further conduct investigations of scientific scenes of interest such as the gulf stream [1,5], polar caps, urban heat islands [6], anthropogenic thermal heat sources, and volcanos e.g. [7].

4) Demonstrate Smallsat Instrument Technologies for Future Planetary Missions.

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Fig. 1 THESIS-Visible Camera with COTS visible detector and lens integrated into a custom aluminum housing and solar shade.

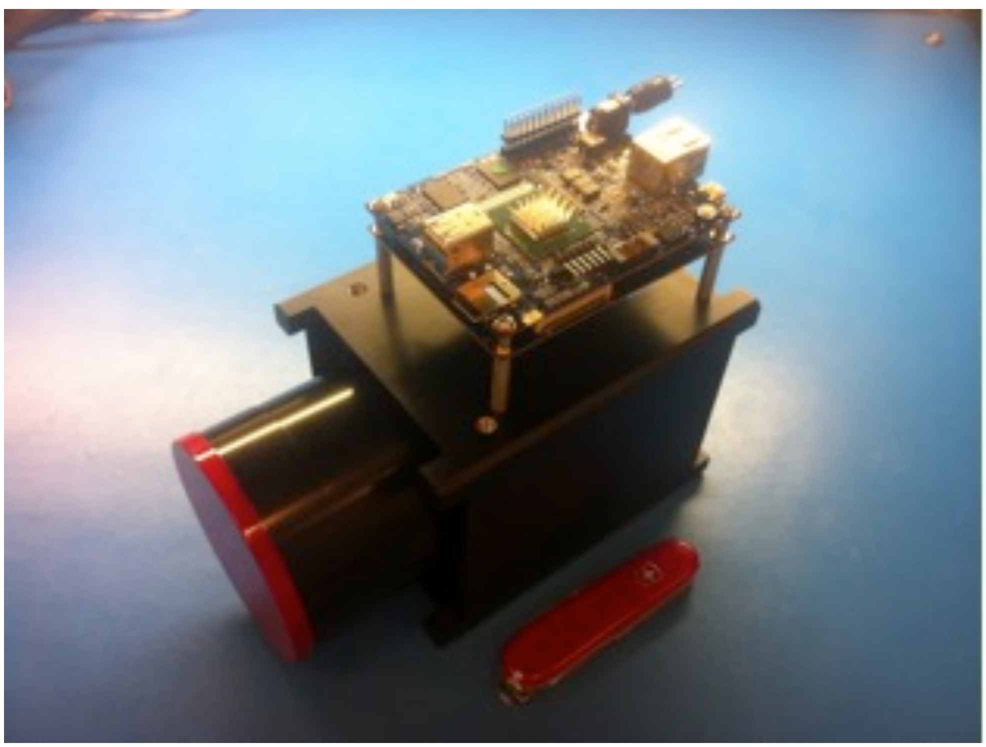

Fig. 2 THESIS-Infrared Camera (bottom) with COTS infrared detector and lens integrated into a custom aluminum housing and solar shade. THESIS-Computer (top) controls cameras and stores images that are processed by algoithms and transferred to *Prox-1* Flight Computer.