Thermographer - Phase I SBIR Summary

Purpose of This Research

The U.S. Air Force has presented us with the opportunity to develop an accurate remote infrared thermographer for measuring human skin temperature at large standoffs. This system must be capable of resolving a small spatial area at a standoff of 1 km, which means a very small field of view. At the same time, this system must offer sufficient accuracy ($\pm$ 1°C), which is ultimately limited by the noise equivalent temperature (NEΔT) of the thermographer. This system must also be insensitive to changes in background radiation as well as the effects of water vapor in the path of the measurement. The current state of this technology measures the temperature-dependent spectrally-integrated radiance of a target using infrared optics and infrared detectors. As discussed in the following sub-section, the technology presently available falls short of meeting the functional requirements of this application because of its limited accuracy, sensitivity to target emissivity, and large spot size at the requisite standoff. Moreover, most of these systems also do not address the effects of water vapor in the measurement path.

We proposed and experimentally demonstrated the feasibility of a color temperature measurement to address this application. Our system consists of two infrared channels defined by two interference filters with neighboring passbands alternating in front of an uncooled amorphous silicon (a-Si) microbolometer. The difference in measured radiance between the two channels is proportional to the temperature-dependent peak wavelength of the spectrum emitted from the target. Normalizing the difference signal by the sum of the two channels makes the measurement independent of target emissivity. We demonstrated this concept during the Phase I using off-the-shelf IR filters and an f/4.5 10-inch Newtonian telescope with a standoff of about 30 meters.

Figure: Phase I System Concept