# Infrared Imaging Systems

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The horizon of infrared (IR) technology extends far beyond the stage of simple curiosity. Given the recent coverage of the Gulf War, not only do the actual users of these systems know of their "smartness" potential, even the general public caught a glimpse of that potential. Interestingly, the manifestation of the IR portion of the spectrum is limited by physiology, not by physics. Thus, to see the unseen, the IR signal is routed through complicated optics, detectors, electronics, and displays. Finally, our eyes have to make sense of the displayed information. To what extent the IR imaging systems are compatible with our various military and commercial needs is thus an important issue to be ascertained. The 20 papers in this special section on "Infrared Imaging Systems," summarizing the works of 44 authors, are fortuitously categorized into four subareas: IR systems, IR systems characteristics and applications, IR systems evaluation, and IR systems modeling.

The first three papers deal with IR systems in general. In the very first paper, Norton conducts an extensive review of various IR detector materials suitable for second-generation IR image sensors. This is followed by a paper by Stauffer and Cole who discuss the design of IR scene projectors using thermal-emitter arrays. Arrays fabricated as silicon microstructures are shown by the authors to eliminate problems such as thermal crosstalk and slow response time. In the third paper, Parsons and Tseng describe the development of a thermal monitoring system for aircraft cargo bay fire safety. Because of its reliability and immunity to false alarm, the system meets the new FAA regulations.

The next three papers deal with IR systems characteristics. In the first paper, Sanders, Currin, and Halford present the visual threshold criteria for the psychophysical IR imaging systems tasks on the basis of an experiment involving a rather large set of stimuli. In the second paper, Nelson, Johnson, and Lomheim discuss the general noise processes in hybrid IR focal plane arrays. Besides considering the standard temporal noise sources, the authors provide an extensive review of various mechanisms that result in "pattern" noise. Next, Farmer presents an analysis of emissivity effects on target detection through smokes/obscurants. The results show that the smoke screen requirement is affected significantly by ratio changes in target-to-background emissivity.

The next five papers deal with several important applications and issues pertaining to those applications. Shushan, Meninberg, Levy, and Kopeika present the results of several experiments that relate weather parameters such as aerosol MTF, wind, solar flux, humidity, and dew with the prediction of thermal image quality. In the next paper, Shepard, Sass, and Imirowicz use a line-by-line image acquisition technique and a scanning imaging radiometer for enhancing temporal resolution. Then, Sanders, Driggers, Halford, and Griffin present results of experiments using frequency-modulated reticles that encode pixel location by light modulation. The technique demonstrated can be used to multiplex multiple pixels onto a fewer number of detectors. This is followed by a paper in which Althouse and Chang use a multispectral thermal imager for chemical vapor detection applications. Finally, Schildwachter and Boreman present the characteristics of a Scophony-configuration IR scene projector.

The third subarea of this special section concerns yet another important aspect of IR technology, namely, the development of tools for the characterization of IR imaging systems. In the first paper, Hubbs, Dole, Gramer, and Arrington use the Mosaic Array Test System for characterizing the radiation effects of IR focal plane arrays. Next, Cathcart and Sheffer show how three-dimensional geometric models with geographic databases, IR prediction models, and computer graphics can be used to generate high-resolution synthetic IR imagery. This is followed by the work of Jolivet and Voynick, in which they modify an existing system to conduct automated testing of a read-out multiplexer for IR focal plane applications. Then, Fraedrich describes calibration and error estimation of imaging radiometers.

The final subarea consisting of five papers deals with the modeling of various IR imaging systems and devices. First, Kennedy presents a two-dimensional model suitable for characterizing the second-generation thermal imaging systems. Next, Gao, Karim, and Zheng present a device nonspecific dynamic performance model for thermal imaging systems. This model is applicable to any arbitrary thermal imaging system while it can also account for the image degradation caused by the dynamic targets. This is followed by a paper by Whitlock, Boreman, Brown, and Plogstedt, in which they develop an electric network model for characterizing SPRITE detectors. Such a model would be useful for corresponding electronics optimization in preamplifier designs, bias circuitry, and read-out mechanisms. Next, Karim, Gao, and Zheng present a critical review of the issues pertaining to the minimum resolvable temperature difference used in characterizing thermal imaging systems. Finally, Kreiss, Tchoubineh, and Lanich describe the results of testing a computer simulation model for evaluating IR atmospherics and signatures prediction.

In conclusion, this special section is well balanced and reports the ongoing research efforts in IR imaging systems at different government, university, and industrial laboratories. I would like to thank the many contributors and reviewers for their dedication. Without their help and timeliness, this special section would not have been possible.

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