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In the 1970's an effort came from the National Cancer Institute's Breast Cancer Detection and Demonstration project. This project was misrepresented as a failure of the technology instead of a failure of the project. Medical thermal imaging is in fact based on the fundamental science of physics and physiology. To put it simply the human body emits copious amounts of infrared radiation and infrared cameras see this radiant energy. Unlike x-rays the process is totally non intrusive. The sensor(s) in the camera are sensitive to emitted radiated energy from the body. You simply look at the body with the camera and you get a thermal image. Interpretation is a major issue in that even biological twins will have a different thermal profile.

## Temperature and the human body

Thermal imaging systems see radiant energy emitted from the first 1/1000 of an inch of the surface of the objects. In fact infrared energy is emitted by every object on the planet. Non contact infrared sensors surround us in modern life on a day to day basis. From traffic lights to the infrared motion sensors in our bedroom lighting, airport toilets, automated doors at the local grocery store or the faucets that turn on and off without a touch; infrared sensors impact our lives daily in a very helpful way!

Temperature is the number one form of measurement used in any process; this includes the human body. When you go to the doctor what is one of the first clinical tests performed? In most cases the nurse will take your temperature and blood pressure. Boyle's law demonstrates there is a direct relationship between temperature and pressure. In fact one of the primary reasons Daniel Gabriel Fahrenheit (1717) developed the mercury thermometer was to measure the temperature of the human body. Hippocrates (400 BC) would cover the body with a thin layer of water and mud and look at the area that would dry first to find internal organs that had an elevated temperature.

Infrared (IR) mechanical scanning technology using liquid nitrogen, thermoelectric or stirling coolers has been around for several years. Line scanner's and line cameras utilizing this technology have been used for years in small numbers for very specific medical applications. In the 1970's, there were more infrared imaging cameras sold to the medical industry than there were cameras sold for electrical and mechanical applications.

Misuse and misdiagnosis as well as falsifying examination results in spinal injury and other cases in the court room, all but destroyed infrared camera use in the field of medicine. A small number of doctors and research scientists have kept the technology alive and progressing forward. The first meaningful study of infrared imaging and breast oncology was performed at the Cancer Institute of Pasteur University in Marseilles France and was published in 1975. This study incorporated thousands of case studies over many years. Also in 1975, Judas Folkman published his theory of neo-angiogenesis of solid malignant tumors. In the late 1980's a group of German anatomist's from University of Essen demonstrated the primitive lacunae structure of neo-angiogenesis. Today thermal imaging studies abound; from a breast cancer study being performed at Cornell University, to a study at the University of Houston using a thermal camera in development of a lie detection system. One thing is for sure, the medical community is again recognizing the value of thermal imaging systems.

## Modern Thermal Imaging Systems

1992 – Honeywell deregulates the microbolometer technology it developed in the 1970's. With advances in nanotechnology and semiconductor manufacturing the sensor size shrinks from the 1970's until it is deregulated and sold for commercial use.

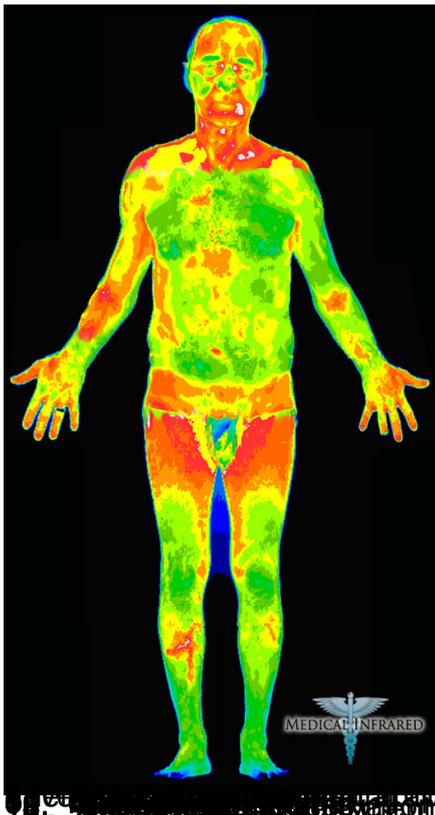
Mid 1990's Honeywell licenses the technology to Boeing, Raytheon, and Lockheed. They all

build the 1st commercial microbolometer based imaging systems for military and commercial applications. Honeywell themselves build the 1st wafers in for Infrared Solutions who are acquire by Fluke, a Danaher company in August of 2005. The detectors at that time have a 50 micron pixel pitch. They are commercially available now in 25, 23.5, and 17 micron pixel pitch. Today there are 13 companies licensed by Honeywell to manufacture microbolometers.

In August of 1997, after 4 to 5 years of development Agema Infrared introduces the 1st hand held imaging radiometer. This 570 system sold for \$49,950.00 and the software package was \$6995.00, bringing the total average sale price of a system to almost \$57,000.00 USD. I know this because I was one of the guys in the field selling these systems. In mid 1998 the Thermovision fixed camera system is developed and cost around \$40,000.00 for the camera, combined with the software for about \$47,000.00 total. It took Agema about six months to get the 570 handheld systems solid and stable, just as many new products today. The first hand held imagers were much noisier in terms of image quality and definitely in comparison with their PTSI, stirling cooled predecessors. Agema was 1st to build a radiometric system although Inframetrics was not far behind. Insight by FLIR managers at the time was seminal. The merger of FLIR, Agema, and Inframetrics helped put them where they are today. Agema was a wholly owned subsidiary of Spectra Physics. In a trade for 46% of FLIR ownership Agema was merged with FLIR. At that time FLIR had not even begun development of the microbolometer technology and yet today they own approximately 75% of the global commercial market.

As the sensitivity of the microbolometer has increased and larger arrays have been developed, the medical uses of infrared cameras have began to expand. Now microbolometer based cameras range in price between \$5000.00 and \$50,000.00. More sensitive stirling cooled cameras range from \$50,000.00 to \$250,000.00. These types of instruments are the ones primarily being used in today's medical imaging systems. Larger quantities of the microbolometer based cameras are being sold primarily because of price. FDA 510K approval is required to sell thermal imaging systems to the medical community and there are a very limited number of manufacturers that have this approval.

## Medical Applications



new papers are being published almost daily. I  
**About the Author**

Gary Strahan is CEO/President of [Infrared Cameras Inc](#) ., located in Beaumont, Texas. He has a PhD in Materials Science from Williamsburg University and attended Lamar University, UCSD, College of Oceanering (Now California Polytechnic), and Don Boscoe Technical Institute. Gary is an honorably discharged Navy veteran. Gary is also an ASNT Level III in thermography, ultrasound, radiography, liquid penetrant and magnetic particle inspection and is a Level II in 4 other methods. He was previously a manager for and Senior Level III for Mobil Oil Corporation and Sales manager for Flir Systems. He was is sole owner of Texas Infrared which started in 1995. Gary began using thermal imaging cameras in 1978 and was owner and manager of West Coast Welding and Inspection from 1983-1987. Gary was at one time a saturation diver, underwater welder, and welding inspector as well. . He is Authorized Inspector for the NBBI (National Board for Boiler and Pressure Vessel Inspectors). Gary is also a Certified API Inspector and at one time was actively involved in NACE and the AWS. Garys name is on the Sabine Charter of the ASNT. He has been working in the field of thermography for over 31 years and is currently a trainer for the

[Infrared Training Institute](#)

. For information regarding ICI's latest medical infrared thermal imaging camera please see the [ETIP Series 7320](#) camera.