ENGINEERING RESEARCH & DEVELOPMENT SERVICES

Creare®

PEOPLE & TECHNOLOGY
FALL 2016

ABOUT CREARE

Creare, founded in 1961, is an advanced engineering research and development firm working in a wide range of industries: aerospace, biomedical, cryogenics, and more. For more than 55 years, Creare has served both industry and government on the frontiers of product and process technology. Our *People & Technology* newsletter provides just a sampling of 100+ active engineering projects.

Creare engineers work on challenging problems requiring multidisciplinary solutions for improved energy efficiency at a time of global need, increased national security, improved medical assessment and delivery systems, and much more.

Creare interns have the opportunity for direct project involvement, whether coding, analyzing data, or designing/building experimental test facilities. Engineering coursework becomes immediately relevant in our R&D environment.

We are a company of approximately 150 people, including 65 engineers. Find more *People & Technology* newsletters on our website.

To learn more, please contact:
Human Resources
careers@creare.com

Creare LLC
16 Great Hollow Road
Hanover, NH 03755
603-643-3800

Creare is an Equal Opportunity Employer. Female/Minority/Disabled/Veteran

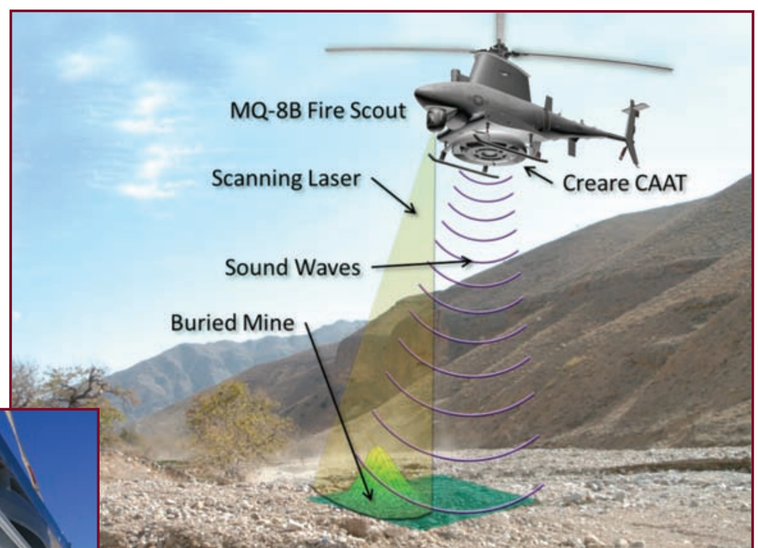
Hunting Landmines with Sound

Landmines and buried IEDs are a real and constant danger to U.S. warfighters in modern conflict zones. These threats persist for decades after the fighting subsides, killing or maiming thousands of civilians (often children) each year. Detecting buried threats safely and remotely from the air can reduce both military and civilian casualties while improving troop mobility. Coupled acoustic-optical techniques are promising at both detecting and discriminating buried targets: sound waves shake the ground and excite responses in buried landmines that can be detected with a scanning laser vibrometer.

The Navy is interested in mounting this system on an unmanned helicopter to enable rapid deployment, quick survey times, and near-complete safety for the soldiers involved. Creare is developing a Compact Airborne Acoustic Transmitter (CAAT) – a lightweight and highly efficient sound source – to generate the high-intensity, low-frequency sound waves necessary to sufficiently shake the ground from altitudes of up to 2,000 feet above ground. Our first-generation prototype met or exceeded the Navy's specifications on size, weight, power, and performance. We are currently working on a second-generation device that reduces the system weight by over a factor of two – enabling deployment on a wider variety of unmanned aircraft.

Success of the CAAT hinges on the novel geometry of the acoustic horn coupling its sound source to the environment. We modeled and optimized the horn shape using finite element methods and manufactured a prototype out of high-strength materials. We then tested the prototype at full power in a custom-built concrete facility at Creare and at reduced power suspended from a construction crane. Airborne testing from a helicopter is planned on a follow-on effort.

Jed Wilbur has an M.S. from Boston University where he studied underwater sound propagation. He also has B.S. and A.B. degrees from Lafayette College. Jed's work at Creare focuses on acoustics, with projects on improved biomedical and industrial ultrasound imaging, hearing protection for extreme noise, functional hearing assessment, and novel communication systems.



Creare's Compact Airborne Acoustic Transmitter (CAAT) shakes the ground using sound waves; this shaking excites responses in buried landmines that can be detected with laser-based detectors.

Creare personnel prepare to test the prototype CAAT suspended from a construction crane.

55 Years Young

On June 21, 2016, Creare celebrated its 55th anniversary since opening for business. This accomplishment has many meanings. For one, it signifies the staying power of a dedicated group of talented technologists. Over these five and a half decades, we have executed thousands of R&D projects for hundreds of clients. Some projects have been small with minimal funding and a term of a day or so. Others have stretched over a decade with funding ranging into the tens of millions of dollars. We have created several new independent companies, and many of them have thrived and are still going strong. We have won dozens of awards and patents. Over the years Creare has adapted to generational and technological change. We have grown to over 60 engineers and broadened from a heavy focus on fluid flow and heat transfer into biomedical, electronics, and electro-mechanical systems. Our facilities have expanded along the way. The constant has been the unwavering dedication to technical excellence exhibited by our staff. We look ahead to many profitable and stable years ahead.

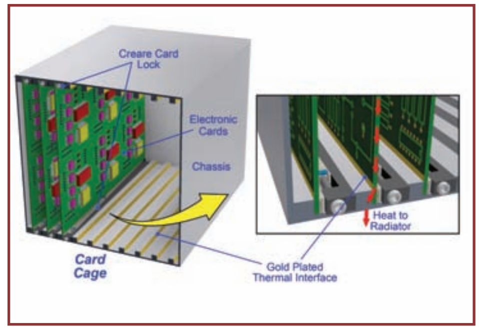
Bob Dean, one of Creare's founders.

Making Electronics Cool Again

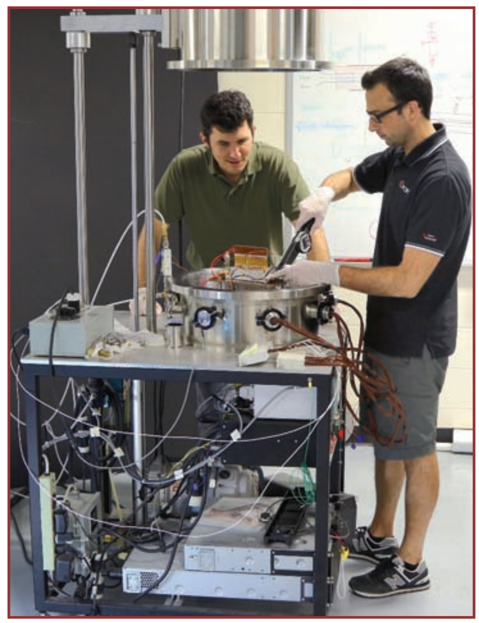
Separable Thermal Mechanical Interfaces (STMIs) are found in advanced digital and analog electronics that are used in space and military systems that are sealed, have little airflow, or must operate at high altitudes. An STMI comprises an electronic card, chassis, and card lock; the card lock provides a thermal interface between a printed circuit board and the side wall of a chassis, from which heat can then be removed via convection or radiation.

Since commercially available card locks are ineffective at removing dissipated heat due to high thermal contact resistance between the boards and chassis, Creare is developing an innovative, drop-in replacement solution. Creare's advanced card lock increases thermal contact area, increases contact pressure amplitude and pressure uniformity, and minimizes interface separation along the length, all of which result in a significant decrease in thermal contact resistance. Creare's technology will enable use of more densely populated circuit boards and higher power dissipating components in challenging thermal environments on earth and in space.

Nick Kattamis received his Ph.D. from Princeton University and B.S. from the University of Connecticut, both in Mechanical Engineering. He has worked at Pratt & Whitney, the Naval Undersea Warfare Center, and Hamilton Sundstrand on such projects as control of augmentor acoustic instabilities and finite element analysis routine customization. Some of his projects at Creare include design, development, and testing of a laser-based composite curing system; a portable friction stir welding system for structural repair; an advanced bearing for the electromagnetic aircraft launch system aboard aircraft carriers; and an active magnetic regenerative refrigeration system.



Typical STMI installation



Nick Kattamis preparing to test the STMI in a vacuum bell jar.

Inside Perspective

Curiosity. That's where it starts. Curiosity fuels exploration. Exploration leads to discovery. And discovery loops back around to inspire new curiosity. It's a virtuous cycle that, for me, drives both professional and personal satisfaction. At Creare, I have the freedom to make opportunities that feed this cycle of curiosity, exploration, and discovery.

I'm an engineer. Like most engineers, I went to school to study a particular type of engineering. In my case, it was mechanical engineering. And when I first came to Creare, that is what I did – mechanical engineering. But quickly my curiosity began looping me into new directions.

Curiosity Loop 1: I got curious about software development. In particular, I enjoyed data visualization. Following this interest, I kept my ears open, heard of a project needing a flexible user interface for exploring time-based data, and talked my way on as a developer. I got to explore the intersection of software development with data. My discovery was that the processing of time-based data is a whole field in itself: signal processing. And I found it to be fascinating.

Curiosity Loop 2: Signal processing led me to be curious about how to get machines to autonomously understand the world around them. As before, I was able to find projects to explore this curiosity. I did speech processing, sonar enhancement, physiologic monitoring, and seismic footstep detection. My discovery was that it's hard to make a machine understand even a small slice of the world, but when it works, it feels like magic.

Testing a seismic intruder detection system, Camp Tango, Arizona.

Chip Audette preparing to test a neurologic sensor.

Curiosity Loop 3: To make the magic happen, you have to take it out into the world. That requires all sorts of hardware: embedded processors, sensors, batteries, and packaging. Suddenly, this mechanical engineer became curious about electronics. So, mashing up my hobbyist love for Arduino with my experience with signal processing, I was able to win projects to support my exploration of electronics, including the development of a low-cost EEG product, an open-source heart monitor, and an ultrasonic voice communication system. My discovery: widgets are good fun to make!

Fresh challenges are what keep me going. I've found that Creare's open structure offers the freedom (along with responsibilities, of course) to make a living by building on my curiosity and following where the exploration and discovery leads.

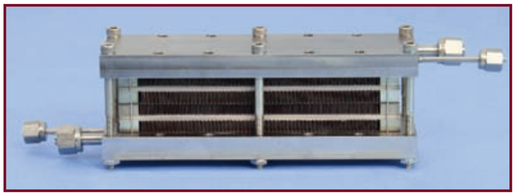
Chip Audette received a B.S. from Bucknell and an M.S. from MIT, then spent time at Lincoln Laboratory, before joining Creare over 15 years ago. His research has spanned a wide range from IC engines to hearing protection to neural signal processing.

Fastener Measurement

One technical challenge in achieving stealth is that the aircraft surface, often referred to as the outer mold line (OML), must be "smooth." Attaching the panels that make up the OML, however, requires lots of fasteners – tens of thousands per plane! Each fastener needs to be installed, filled, and painted. This process is conceptually similar to filling screw holes in drywall, except that almost all OML surfaces have some degree of curvature. Under Navy and Air Force funding, Creare has developed a hand-held fastener measurement tool (FMT) that may be used to quickly assess the OML at different stages along the assembly line to ensure that the final filled fasteners are sufficiently "smooth." The FMT uses structured illumination to rapidly acquire a three-dimensional scan of the OML surface and fastener. Creare's FMT provides results faster and with greater reliability and repeatability than existing manual techniques. In the past six months, Creare has worked closely with our sister firm, Edare, as we prepare to manufacture and supply FMT systems to support F-35 Joint Strike Fighter production.

Creare LLC
16 Great Hollow Road
Hanover, NH 03755
603-643-3800
Fax 603-643-4657
www.creare.com

Keeping It Cool in the Air



Gravity Insensitive Condenser to recover water from humid process flow for NASA's Regenerative Life Support System.

Many advanced electronics and photonics systems for future spacecraft and military aircraft, including phased array detectors, radar systems, and fiber laser systems, require effective cooling at very uniform temperature over large areas. Many of these cooling needs can be addressed only with advanced Thermal Management Systems (TMSs). Creare has been actively developing innovative solutions for these systems. The development efforts in this area range from conceptual thermal architecture design, system design trade-off study, critical component hardware design and fabrication, and prototype system integration and demonstration.

The extreme thermal environments and the absence of a constant body force make it very challenging for two-phase TMSs to provide reliable, stable cooling. For example, spacecraft microgravity environments and military aircraft variable acceleration environments present unique challenges to a two-phase TMS, especially for vapor-liquid phase separation. Ineffective vapor-liquid separation in a two-phase pumped loop can cause vapor ingress into the liquid circulation pump, causing the circulation flow rate to abruptly decrease which could lead to thermal runaway in payloads. Similarly, in a vapor compression system, ineffective vapor-liquid separation can cause liquid ingress into the vapor compressor, reducing its reliability.

For NASA's future remote sensing science missions, Creare is developing an innovative reconfigurable two-phase pumped loop design. The loop has innovative design features to maintain the temperature of payload electronics within a very tight range of ±30 mK even during most rapid heat sink thermal transients anticipated for spacecraft. The design is made possible by Creare's membrane vapor-liquid phase separator, actively controlled two-phase accumulator, and freeze-tolerant condenser/radiators. The phase separator incorporates a unique capillary structure with a very large surface area to enable effective vapor-liquid phase separation by surface tension effects. The energy-efficient, active control mechanism in the accumulator precisely regulates the loop pressure to tightly control its cooling temperature. The freeze-tolerant condenser/radiators with variable thermal conductance allow spacecraft to rapidly increase their heat rejection capacity when they emerge from the shadow of planets or moons.

Weibo Chen received his Ph.D. in Mechanical Engineering from The Ohio State University. Dr. Chen's fields of interest include a wide range of thermal and fluid engineering problems, particularly in two-phase flow thermal management systems, cryogenic cooling systems, and advanced heat exchangers, pumps, and compressors for these systems.

Senior Engineer Weibo Chen and Contracts Administrator Sarah Teffner

Upper Valley Living

Creare's location in Hanover, New Hampshire, offers the best of four-season living in a New England college town. The area offers excellence in medical centers and schools, a wide range of affordable housing options, and cultural amenities offered by Dartmouth College.

Creare's location in the midst of this pristine area offers a wonderful array of fun activities for all ages and interests, and a beautiful drive to work for all.

Activities change with the seasons. The casualness of Creare promotes collegial opportunity to enjoy hiking trails on our back 30 acres, mountain biking, cycling, running, skiing or snowshoeing during lunch, after work, and on weekends. Lunchtime activities include on-site exercise classes, and team sports like volleyball, football, and soccer. After work, paddling is a favorite summer-time outing.

Travel to and from the area is made easy by the I-89/91 interstates, Dartmouth Coach daily service to Boston and New York, the Lebanon airport (a small jetport), and easy access to Manchester, New Hampshire, and Boston Logan international airports.

You can balance lifestyle and personal interests with a challenging and rewarding engineering career at Creare.