ENGINEERING RESEARCH & DEVELOPMENT SERVICES

Creare®

PEOPLE & TECHNOLOGY
FALL 2017

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 our 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.

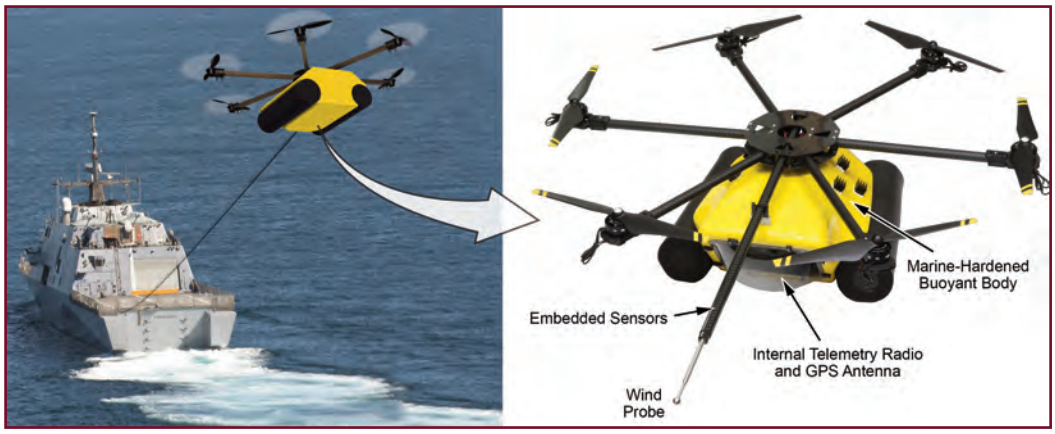
We are a company of approximately 150 people, including 65 engineers. Find more *People & Technology* newsletters on our website.

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

Unattended Aerial Sensor Platforms



Keeping a multi-rotor aircraft stable in turbulent air

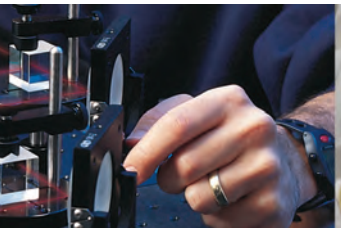
Imagine flying a lightweight low-cost drone. Challenging but doable. Now imagine doing that in the turbulent air-wake of a ship to measure atmospheric parameters. Harder. How about unattended? The Navy relies upon pressure, temperature, and humidity data to model electromagnetic propagation through the atmosphere, which dramatically improves accuracy of ship-based radar systems. NOAA (National Oceanographic and Atmospheric Administration) and the NWS (National Weather Service) utilize similar data for short- and long-term weather forecasting and climate modeling. Existing unmanned platforms that could do the job are often too expensive. Creare has been actively developing several multi-rotor and fixed-wing unmanned aerial systems (UASs) to address the needs of the atmospheric-sensing community including the Navy and NOAA.

Preparing for a flight test

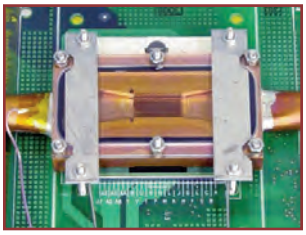
Creare's UAS portfolio covers both platforms and sensor packages. We use long-endurance fixed-wing platforms for access to remote locations (such as the Arctic) and rotorcraft for shipboard launch and recovery. One of our multi-rotor platforms is designed to record vertical atmospheric profiles similar to balloon sonde systems but with the added benefits of significantly lower cost, long-term unattended operation, and the ability to capture many profiles per day.

Creare's improved UAS technologies will improve data collection and modeling accuracy for the atmospheric observation community at large. These improved models will lead to more streamlined operations for DoD (Department of Defense) needs and better insights into small-scale and large-scale atmospheric processes and phenomena that impact the world.

Benjamin Cameron received his B.S. and Ph.D. in Mechanical and Aerospace Engineering from the University of Virginia. His work at Creare spans a wide range of disciplines including thermal systems, structural systems, aero-dynamics, hydrodynamics, sensors, power electronics, and energy systems. Some of Dr. Cameron's other projects at Creare have focused on design of technologies for the Navy's SSC (Ship-to-Shore Connector), EFV (Expeditionary Fighting Vehicle), and ACV (Amphibious Combat Vehicle) programs and development of novel motorcycle helmet technologies for the Department of Transportation.



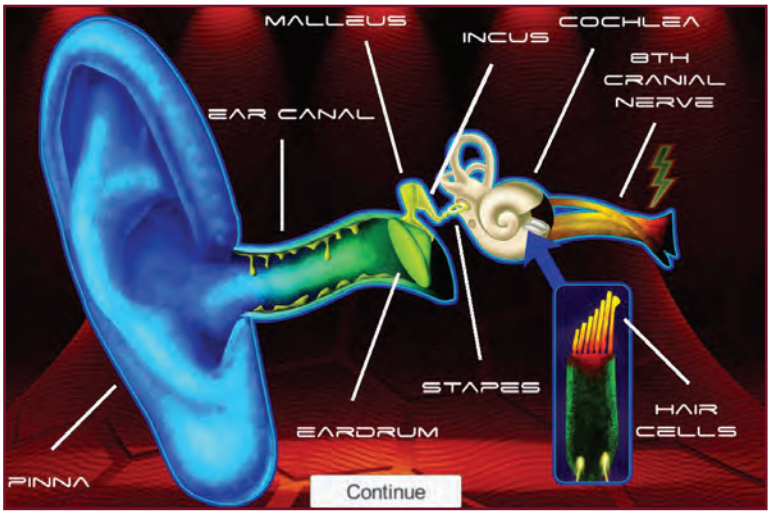
Industrial-Strength Consulting



Throughout its history, Creare has maintained a balanced portfolio of industrial and government customers. We are recognized in industry circles as a valuable problem solver and an innovative partner for product development. Creare is responsive to the quick tempo of industrial development. Working in close collaboration with the client's technical team, we are more than just "engineers for hire" – we provide guidance, advice, and critical direction in order to meet the customer's goals.

For example, we evaluated a wide range of advanced electronics cooling concepts for a leading semiconductor company. Other industry-sponsored projects over the past year have involved cryogenic system development, advanced heat exchangers, biopharmaceutical production, and conversion of waste to energy. One recent client described the relationship this way: "Since our company's inception…the Creare team has continually worked side-by-side with ours to understand and solve critical design and engineering challenges. Their valued counsel has aided us in developing a new, innovative technology…"

Learning About Hearing–The Fun Way



Screen shot from the game showing parts of the ear

Engaging gameplay is enticing

How do you entice young people to study science? Make it a computer game. While admittedly not an original idea, Creare is working on building such a game in one of our clear areas of expertise: audiology. We teamed with Strangeheart Games and Dangerous Decibels to create a game called Song of the Starbird to teach hearing and acoustics to 5th graders to help promote hearing health and reduce noise-induced hearing loss (NIHL).

In the game, the player becomes an alien explorer from planet Whisperwell, sent to planet Bumble Thump to find the legendary Starbird. To explore and collect hidden items, the player travels around the world listening while avoiding overexposure to loud sounds that can damage their ears. Knowledge about the physics of sound and the dangers of NIHL helps the player achieve victory. Additionally, the game provides students context for mathematical concepts like waves and logarithms, helping provide an answer to the age-old question: "Where am I ever going to use this stuff?"

Developing Song of the Starbird requires a multidisciplinary team that integrates Creare's technical expertise in software development, acoustics, and mathematical modeling with the psychology of learning and the art of entertainment. We carefully balance quantity of educational content with engaging and fun gameplay. The core mechanics of the game closely model real physics and can be used as a digital sound laboratory. Sounds in the game visually interfere constructively/destructively, the amplitudes of sounds follow the inverse square law, and the health system is based on real exposure limits. The game's efficacy is tested with human studies and suggests that students can be educated while being engaged and entertained at the same time. Song of the Starbird will enable teachers to use classroom time more efficiently, while engaging, entertaining, and educating a new generation of engineers, scientists, and mathematicians—or at least getting them to turn their earbuds down.

After receiving a B.S. from the University of Waterloo in Canada, Matt Ueckermann earned his M.S. and Ph.D. from the Massachusetts Institute of Technology in Mechanical and Computational Engineering. Since joining Creare, his work has included real-time image processing, geospatial data processing and assimilation, novel refrigeration devices, and modeling turbulent flows in jet engines.

Inside Perspective

Do you remember when, as a teenager, you had to decide what you wanted to do with your life? I decided based on wanting to make a difference in a world mined with difficult challenges: poverty, global warming, overpopulation, diseases, space exploration, etc. It's very easy to lose sight of our teen aspirations, but I'm very happy that my work allows me to stay in touch with them. I am able to make contributions to these problems every day.

Creare's unique structure and work environment enables me to pursue my interests. Working with teams of multidisciplinary experts, I feel empowered to do exciting engineering work, motivated by big-picture goals. For example, I have helped develop software to administer low-cost neurocognitive assessments; modeled fluids in the human body to understand microgravity effects on the eye; and designed, optimized and tested cutting-edge heat exchangers for various applications.

While driven by my big-picture goals, I value enjoying my day-to-day activities. Recently, I designed and built a wireless pressure monitoring system to measure pressure fluctuations within protective garments. The system's pressure sensors and Raspberry Pi mini-computer can all be conveniently worn on a belt. As the subject performs various movements, the system measures the pressure under the suit at various locations, and wirelessly transmits the data to a laptop for live display. I am currently closing the design loop by using the system to validate Creare's physics-based model.

The broad range of projects that each Creare engineer works on is striking, which is a big part of what I love about Creare. The project-based work environment means I work on multiple projects at a time. Each project has different time scales, requires different technical skills, and is driven by different motivations, which keeps me highly engaged and interested.

The variety of projects leads me to collaborate with amazingly smart people who are often amongst the most knowledgeable in the world in their field. Creare's unique structure fosters both constructive relationships and personal growth and performance. I have grown tremendously as an engineer since joining Creare, developing skills faster and better than I would have imagined possible.

A family walk, around Mascoma Lake

In addition to the fantastic work environment, I enjoy Creare's friendly, active, and accommodating workplace. I participate in lunch-time activities such as exercise classes, football, soccer, and volleyball. I build friendships with my coworkers. Having two children under three years old, I take advantage of the schedule flexibility to juggle my family life and my stimulating work.

I grew up in Montreal, traveling to the countryside every weekend. Growing up in this bi-modal lifestyle emphasizes how lucky I am to live in an area that combines the benefits of the city and the countryside. The Upper Valley is small enough to avoid congestion and overpopulation, yet large enough to have plenty of shopping, restaurants, and other services. With abundant mountains and lakes, it has most of what vacationers seek in their second home such as skiing, rock climbing, boating, etc. Regularly ranked in the top five places to live in America, Hanover and Lebanon are family-oriented and great communities to raise kids. Creare is a gem of an engineering company: it gives engineers the freedom to pursue their passions, and it resides in a wonderful living area.

Veronique Archambault-Leger received her B.S. in Chemical Engineering at UNH and a Ph.D. in Engineering at Dartmouth, where she analyzed and optimized a hydrothermal pretreatment method for cellulosic biofuel production. She joined Creare in 2014 as an engineer. Her interests include heat and mass transfer, thermodynamics, fluid dynamics, software development, biomedical engineering, sustainability and renewable energy generation and storage.

A New Space

After decades in one location (Great Hollow Road in Hanover, NH), Creare has expanded into a new space a few miles away in the Centerra Industrial Park in Lebanon, NH. We are sharing the new facility (over 20,000 square feet), with our sister company, Edare Inc. We formed Edare in 2010 to handle low- and mid-volume production of technologies and products invented at Creare. By maintaining a close relationship between the companies, we can more carefully nurture and track conversion of selected innovations to products, especially those with high engineering content. With several Creare employees having moved to the new facility, we expanded our phone and computer network there as well. Now we operate as if everyone is located in one big facility. The Centerra facility includes both office and lab/shop space. The approach of renting new space differs from our past practice—which was to add another building to the Great Hollow campus. It has afforded us a new opportunity to grow our community beyond our current building footprint.

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

Making Batteries Safer

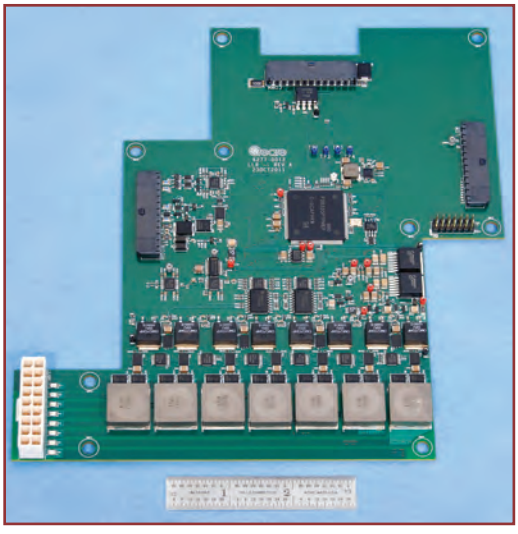
Lithium-ion (Li-ion) batteries are excellent electrical energy storage devices for commercial and military platforms, but as demonstrated in some small consumer electronics, they can suffer catastrophic loss. One can imagine the damage potential in larger systems. To realize the benefits of these batteries in applications like electric and hybrid electric vehicles, directed energy weapons, and renewable energy grid storage, Creare is developing novel approaches to alleviate thermal runaway risks.

One such technology is an innovative phase-change thermal management system. Phase-change heat transfer has proven to be better than seven times more effective at removing waste heat than conventional conductive approaches. Keeping cells cooler through enhanced thermal management provides greater operating margin before self-sustaining or self-propagating thermal runaway events occur.

Another technology, Creare's fail-safe Battery Management System (BMS), can detect emergent cell faults within large-format battery packs. The BMS electrically removes suspect cells from the system to avoid further damage while providing limp-along capability with the remaining healthy cells. Additional health prognostic information is critical to safe operation and cost-effective maintenance and logistics of these critical energy storage devices.

These two independent, yet complementary methods promise to significantly reduce the operating risks associated with Li-ion batteries. These technologies are key pieces needed for ubiquitous deployment of large Li-ion storage banks for everyday applications.

Dr. David Fogg holds a M.S. and Ph.D. from Stanford University and a B.S. from RPI, all in Mechanical Engineering. In addition to battery technologies, his core interests lie in novel thermal management systems including two-phase cooling for spacecraft, microchannel heat exchangers, and vapor compression systems.



A Creare battery management system

Testing a phase-change solution

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.