

ABOUT CREARE



Creare develops innovative technology and products for clients across a wide range of fields: aerospace, biomedical, cryogenics, and more. Since 1961, 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 multi-disciplinary solutions for improved energy efficiency at a time of global need, increased national security, improved medical assessment and delivery systems, and much more.

We are a company of approximately 190 people, including 80 engineers. Find more *People & Technology* newsletters on our website.



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

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



Modernizing Transportation Infrastructure with AI



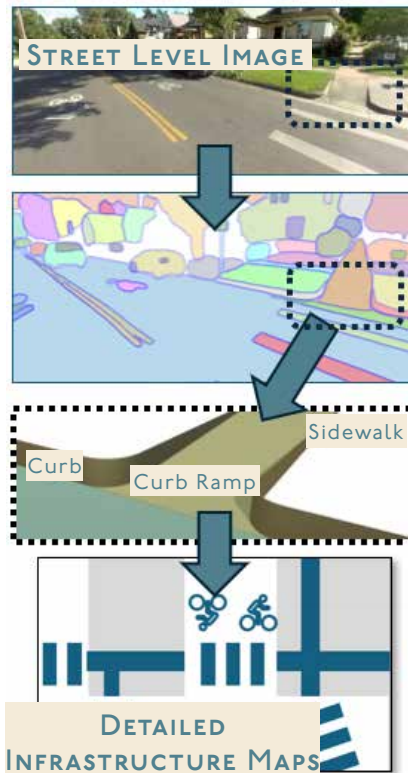
The author riding his bicycle to Creare. The technology Creare is developing will recognize crosswalks like the one pictured here to build infrastructure data of the complete transportation network.

In modern, congested cities, active transportation modes such as walking and cycling are becoming more important because of their health benefits and because they reduce traffic stress. City planners are now designing transportation infrastructure projects that consider the complete transportation network. But do cities even know where their sidewalks are? In many cases the answer is no...

To help solve the transportation infrastructure data desert problem faced by cities, Creare is developing StreetPulse, a functional digital twin system that generates rich infrastructure data from street-level imagery. Our software leverages artificial intelligence to understand images and recognize elements such as sidewalks, road signs, lane markings, and even potholes. At its core, StreetPulse generates a high fidelity, georeferenced, 3-D reconstruction of the environment with individually labeled and segmented infrastructure elements. It then distills this complex digital city model into geospatial information system (GIS) layers that planners want to use. For example, StreetPulse can generate GIS layers of sidewalk networks while also packing in extra useful information like the overall sidewalk

condition, its width, and maximum unobstructed width. This not only lets cities know where their sidewalks are but also answer if there's a tree in the middle of a segment!

We recently completed a successful feasibility study as part of the U.S. Department of Transportation's "Artificial Intelligence for Transportation Planning and Design" initiative. In this study we reconstructed an intersection from about 30 street-level images. We showed how our system can identify the different infrastructure elements and reconstruct them with great accuracy, even capturing the curbs. As part of this effort, we spoke with officials from large cities, state-level transportation agencies, and small towns, all of whom were excited by our approach. We are currently making plans to develop a prototype so that more people can get to where they're going with greater freedom. 🌀



Matt Ueckermann has been an engineer at Creare for over a decade and goes to work on foot, bike, and occasionally skis. A mechanical engineer by training, he works on projects that involve scientific software development ranging from 3-D reconstruction to weather prediction. He completed his PhD and M.S. degrees at MIT where he developed finite element methods for ocean models. He did his B.S. at the University of Waterloo.



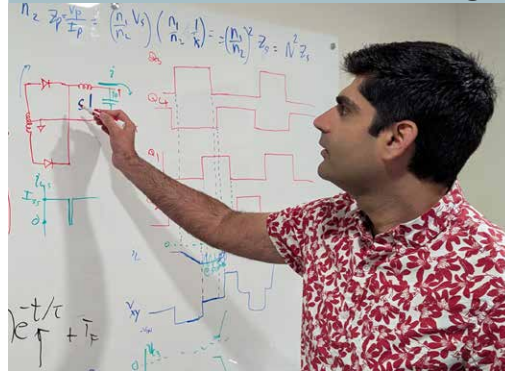
INNOVATING AIRCRAFT REPAIR

The DoD and commercial aerospace markets require novel technologies to effectively and efficiently repair metallic aircraft components. Conventional approaches, such as fusion welding or standard friction stir welding, result in excessive heat addition or require high forces and torques, respectively. In addition, the facilities needed to complete such repairs make doing so in the field impossible. As a result, components are typically removed from the aircraft for assessment and disposition. Components with defects that cannot be blended while maintaining adequate strength are often discarded and replaced with new, costly parts. Lead times can be very long, and in many instances, parts are no longer available for aging aircraft.



Creare has been developing a novel material addition process that uses compact, high-speed spindles and consumable “tools” to reduce forces and torques during material deposition. Through extensive research, we determined that the forces and torques for our “additive” friction-stir process decrease exponentially as the spindle speed increases for a variety of aerospace materials including titanium alloys, stainless steels, and aluminum alloys. Accordingly, we can complete these repairs with compact, even handheld tools. Our systems substantially reduce bulk heating to the component under repair when compared to fusion welding, significantly reducing residual stresses, the heat affected zone, and cracking. Our ability to package these innovative tools in portable configurations offers distinct advantages for completing repairs in the field for timely system sustainment. This enables the DoD to take the tool to the part, rather than take the part to the tool. The outcome will someday be on-aircraft repairs, returning the component to full strength while saving the DoD money and eliminating the lengthy downtime associated with part procurement.

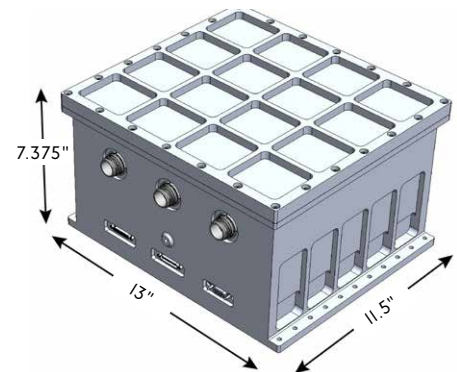
Cryocooler Technology for Space Flight



Future space exploration missions, particularly long-duration excursions to planetary destinations like Mars, will require reliable long-term storage of cryogenic rocket propellants such as liquid hydrogen (LH₂) and liquid oxygen (LOX). Active refrigeration systems are needed to keep these cryogenes from boiling away during long storage periods in large tanks with correspondingly large heat loads. To enable long-term storage with zero boiloff, Creare has recently demonstrated and delivered a high-capacity, single-stage reverse turbo-Brayton (RTB) cryocooler for NASA. The RTB interfaces directly with broad-area cooling components located on the storage tanks or thermal shields and enables very high cooling capacity. Creare’s RTB cryocooler produces over 150 W of cooling at a temperature of 90 K (-300°F), which is 5–10 times the capacity of currently available space cryocoolers at this temperature.

Creare is also developing a Cryocooler Control Electronics (CCE) system for NASA

for control and operation of the 90 K, 150 W RTB cryocooler. The CCE communicates with the spacecraft to receive commands, convert power for cryocooler operation, and transmit system status data.



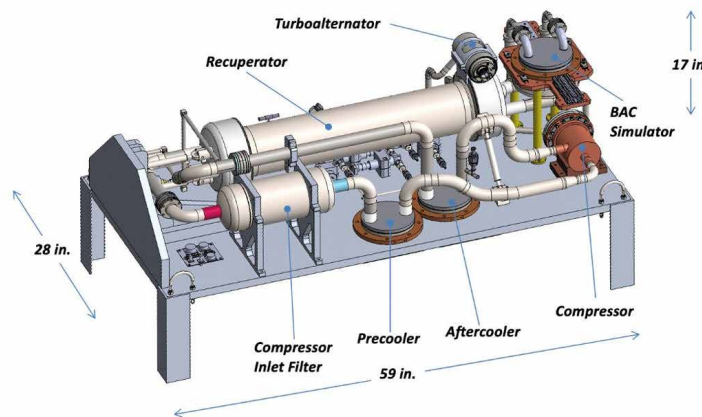
Creare’s Engineering Model Cryocooler Control Electronics

The CCE continuously monitors parameters such as load return temperature or storage vessel pressure and operates in a closed-loop mode to control cryocooler operation and prevent loss of the cryogenic propellant.

Creare is currently completing the fabrication, integration, and demonstration of an Engineering Model CCE to control and operate the cryocooler using a simulator in place of the actual cryocooler hardware. The testing will verify that the CCE meets all functional and performance requirements in a flight-representative configuration. Functional testing with simulated loads will establish

Technology Readiness Level (TRL) 5, with further environmental and operational tests planned to reach TRL 6, qualifying the system for integration into flight missions.

This development advances critical cryogenic refrigeration and control technologies needed to enable longer, more capable deep space missions with active cryogen storage.



Creare’s 150W/90K Reverse Turbo-Brayton Cycle Cryocooler

Amir Mirbeik received his Ph.D. in Electrical Engineering from the Stevens Institute of Technology, where he received the inaugural Paul Kaplan Award for Distinguished Doctoral Work. Since joining Creare, Dr. Mirbeik has led the development of electronics for multiple projects, including two radiation hardened cryocooler control electronics for NASA.



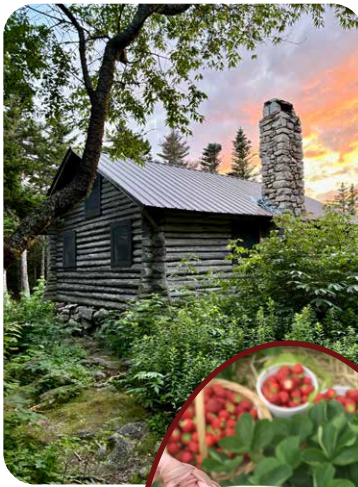
Inside Perspective




Coming out of grad school, I was excited to begin my engineering career in earnest and broaden my expertise. After spending five years focused on bubble physics, I was ready to diversify the topics I worked on and the skills I used in the day-to-day. Initially, I was drawn to working in a startup environment with small teams where everyone makes an impact, flat company structure, and plenty of opportunities to grow. After interviewing at Creare, I realized I could have all that and more — whereas startups generally focus on one technology or product, at Creare I could work on multiple projects at the same time.

In the year and a half since I started at Creare, I'm amazed at the number and diversity of projects I've been able to contribute to. These have included designing space cryocoolers, testing and modeling aerosol collection technologies, and analyzing the performance of powered respirator masks. Each project requires shifting between the roles of design, testing, analysis, and project management, across many technical domains. Through these projects I've been able to grow my technical skills and learn the process of moving ideas from early research all the way to commercialization. Much of my learning

is thanks to the collaborative environment at Creare, with many formal and informal mentors and a friendly collegial atmosphere. In addition, having so many projects under one roof makes it easy to follow your curiosity into new technical areas.



As a New Hampshire native, I was very pleased that starting at Creare meant having close access to the outdoors again. Having spent the last five years in Boston, I found myself dreaming of jumping into pristine swimming holes after a long hike, overindulging on freshly picked summer strawberries, or enjoying the tranquility of cross-country skiing through a forest after a fresh snowfall. Creare's location in Hanover, New Hampshire, offers classic New England charm and endless outdoor activities.

With all these factors combined, I'm very grateful to have landed in such a supportive, engaging environment, and I'm excited to keep growing and exploring in new directions. 

Lena Dubitsky completed her Ph.D. and M.S. degrees in Mechanical Engineering at Boston University, where her research focused on understanding the physics of bursting ocean bubbles. She completed her B.S. at Princeton University. At Creare, she works on a wide variety of projects including the modeling, design, and testing of aerosol collection systems, space cryocoolers, acoustic barriers, and biomedical technologies.

FMT TECHNOLOGY TRANSITION: FULL MEASURE OF SUCCESS

One of the Creare's most successful R&D-to-product transitions is the Fastener Measurement Tool (FMT), a handheld laser inspection tool designed to measure fastenings on the outer mold line (OML) of aircraft. Creare's affiliate, Edare, transitioned the FMT to market in 2017 with delivery of 19 FMTs to Lockheed Martin's F-35 production line in Texas. This followed over a decade of laser metrology technology development spanning many projects at Creare; several related R&D efforts are also currently underway at both Edare and Creare.



Edare licensed the FMT technology from Creare for production, and the teams at both companies have steadily evolved the FMT since the first deliveries. Nearly every F-35 built in the U.S. has every OML fastener inspected, at least once, by the FMT. The U.S. Department of Defense has identified the FMT as one of the key technologies needed to meet the F-35 production rate goals.

Today, hundreds of FMTs have been deployed to a diverse array of customers in the aerospace industry, and Edare has developed a third generation of the tool. At least 12 programs (including F-35, F-22, and B-21) are now leveraging the FMT. Edare has contracted deliveries pushing through 2027 and has recently made its first deliveries to both the commercial and European aerospace markets. Looking forward, we're working to build our team and continue to improve the tool to ensure the FMT can continue to grow into new markets.






Lightweight, Strong, and Electrically Conductive Concrete



Concrete has been used in construction for centuries and is a quintessential material chosen for building large structures to this day. However, autoclaved aerated concrete (AAC), a precast, steam-cured, lightweight concrete, is a newer construction material with great potential. Often used in walls, floors, and ceilings in commercial buildings, especially in Europe, AAC can be up to 4 times less dense than traditional concrete, making it a good thermal insulator, and blocks can be prefabricated within 24 hours. One limitation of traditional AAC is that it is not as strong as normal concrete due to its lower density.

reductions in cement usage in concrete mixtures can have a large effect. The additives that we are developing also make the concrete electrically conductive and strain sensitive, allowing for applications like electromagnetic interference (EMI) shielding, resistive heating, and structural health monitoring.

During the initial phase of this work, we focused efforts on modifying the mortar that ties the precast AAC blocks together, demonstrating a 5x strength improvement and 3 orders of magnitude change in conductivity compared to standard mortar recipes. In the current phase, we have developed a baseline AAC recipe cured using a micro-autoclave. Now we have produced our first carbon nanomaterial-loaded AAC samples that are showing very promising results. 



The authors examining AAC samples (above) and a closer look at the samples (right).



Creare is developing carbon-based nanomaterial and metal fiber additives for AAC to increase the strength of AAC while retaining its low density. By reducing its weight compared to standard concrete while maintaining high strength through the additives, our technology will greatly reduce the overall energy footprint and costs of AAC construction. The concrete industry contributes approximately 8% of the world's carbon emissions, so even minor

Michael Swannick received his B.S. degree in Mechanical Engineering from Northeastern University and both his M.Phil. in Material Science and Ph.D. in Electrical Engineering from Cambridge University. He followed his Ph.D. with post-doctoral research at MIT. His previous research focused on nanowire growth and devices. During his 11 years at Creare, he has developed novel material processes and applications for high brightness x-ray sources, energy harvesting, nanotube heaters, and bio-mimetic adhesives.

Michael Durso earned his B.S.E. and Sc.D. degrees in Materials Science and Engineering at Arizona State University and the Massachusetts Institute of Technology, respectively. His research background includes inorganic and carbon nanomaterials, advanced polymer synthesis and characterization, and composites. In his first year at Creare, Michael has supported materials selection, design, and software efforts for composites, cryogenics, heat sensors, and dust collection.

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 and the community.

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 summertime 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.