

AEROCOM

JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES

WINTER 2021





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AEROCOM | WINTER 2021

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I am honored and humbled to have been selected as the fourth Dean of the John D. Odegard School of Aerospace Sciences. I am also very excited about the future of our programs. I want to start off by expressing my gratitude to Paul Lindseth for his leadership for the past four plus years and wish him well as he will take some well-earned developmental leave for this year before returning to the Aviation Department next January.

Due to the dedication and leadership of our flight training staff, maintenance shop, line staff, flight instructors, and most importantly our students, the summer and fall resulted in more than 86,000 hours awarding more than 1,090 certificates or ratings. Additionally, new enrollments increased again in the fall semester, all while continuing to operate under COVID restrictions. We are also starting to see airline hiring start up again as well as positive signs coming from the partnership programs.

Air Traffic Management students and graduates celebrated last year with the passage of the Air Traffic Controller Hiring Reform Act of 2019 which reinstated the benefits of attending a Collegiate Training Initiative program. We are now starting to see some movement in that hiring as more training slots are opening up and our graduates beginning their civil service careers.

A recent report from the Mercatus Center ranked all fifty states for preparedness for commercial drone use and North Dakota came out on top again. A lot of the groundwork that led to this ranking is due to the Odegard School and the establishment of the Northern Plains UAS Test Site. The Unmanned Aerial Systems program continues to grow in both quality and quantity and like the Air Traffic Control, is now part of the newly-established FAA Collegiate Training Initiative program for UAS. We are looking forward to hosting the Collegiate Drone Racing Championship in mid-April, following many of the guidelines that our athletic teams have been using for competing under COVID restrictions.

In Atmospheric Sciences, we said farewell to Gretchen Mullendore as she moved to the National Center for Atmospheric Research in Colorado and thank her for serving as the Department Chair and for being a prolific researcher and teacher. Matt Gilmore has been chosen to serve as the interim Chair while a search is conducted. We are planning to allow in-person internships this summer so we may have students participating in weather modification.

Space Studies hosted several high-profile visitors this past year and we are working to capitalize on those and get more involved in national security-related space research. Under Dr. de León's leadership, the Mars habitat and space suit research continues and Dr. Fieber-Beyer recently published in the Planetary Science Journal after discovering the source of many meteorites.

Our Earth System Science and Policy faculty and students continue to address today's environmental challenges and will be looking to grow the sustainability studies minor while attracting more partners and students for the graduate programs.

Overall, both faculty and students are looking forward to returning to more in-person interactions but through this pandemic, everyone has stepped up to continue the mission. We've learned a lot along the way and will continue to work together as leaders to create, preserve and deliver the highest quality education, research and services in aerospace and related sciences for our university, our state and the worldwide community.

Have a great Spring and I look forward to meeting many of you at homecoming in the fall.

ROBERT KRAUS | DEAN, JOHN D. ODEGARD SCHOOL OF AEROSPACE SCIENCES

A handwritten signature in black ink that reads "Robert Kraus". The signature is written in a cursive, flowing style.



**CONGRATS TO
THE WINTER
2020 GRADS!**

GET TO KNOW DEAN KRAUS

Since I'm new to UND and the Grand Forks region, I wanted to give you some of my background and how I see the Odegard School continuing its leadership role in Aerospace Sciences.





I come to UND having worked at Kent State University as the Associate Dean for Flight and Operations in the College of Aeronautics and Engineering. Prior to that, I served in the Air Force for 28 years retiring as a Colonel in 2019. Before I go into those details, I'd like to go back a little farther.

I'm originally from Ohio, near Cleveland and have been a lifelong Browns, Indians, and Cavaliers fan, through good times and bad—mostly bad. After High School, I was given the opportunity to go to the US Air Force Academy. It was there that I was able to start my career in Aerospace, as an Aeronautical Engineering major, Russian language minor, and glider (sailplane) instructor. Following graduation and commissioning as a second lieutenant, I shipped off to pilot training at Sheppard Air Force Base which led to my first assignment as a C-141B pilot at Travis Air Force Base.

I thoroughly enjoyed my time flying airlift, medevac, and humanitarian support missions around the world. An opportunity arose for me to move to Edwards Air Force Base and I completed the US Air Force Test Pilot School, flying and evaluating more than 31 airplanes and helicopters. Upon graduation, I transitioned to the brand-new C-130J and was part of the team completing the developmental testing with Lockheed and conducting mission acceptance and qualification testing. This led to working with one of the first units to receive the new aircraft, the Hurricane Hunters, to clear the aircraft for hurricane reconnaissance missions. I was also able to complete a Masters Degree in Mechanical Engineering through Georgia Tech's Distance Learning program.

I moved back to the US Air Force Academy to serve on the faculty in Aeronautical Engineering, teaching across the mechanical and aeronautical engineering disciplines. I also had the opportunity to get more involved in one of my hobbies—bicycling and took on the role as the Officer-in-Charge/Coach of the Academy's Cycling Team. The best thing that happened during this assignment was meeting my wife, Heather.

Prior to leaving Colorado Springs, my wife and I both trained to become USA Cycling race officials and started officiating at the velodrome, then moving to road racing and eventually mountain biking. Our race officiating continued for my next three assignments. First we moved to New Jersey, then to Virginia Tech for a PhD in Aerospace Engineering, then back to the Academy.

My second tour on the faculty at the Academy saw me move into the front office working for our Dean/Provost and then as the Chief Scientist and Director of Research, coordinating the activities across 21 research centers and institutes. This position led to us moving to the Washington, DC, area working at the Air Force Office of Scientific Research, overseeing 36 program officers whose portfolios managed more than \$500M annually in research grants to universities and small businesses for Air Force basic science research.

I then had a chance to re-enter the operational side of the Air Force and deployed to Bagram Airfield in Afghanistan as the Wing Chief of Staff, overseeing the various wing staff agencies and working with other base leaders to keep the runway open to the maximum extent possible.



Upon returning from deployment, my wife, our dog, and I, immediately flew across the Atlantic Ocean to Paris, France, where I worked with the NATO Science and Technology Organization for my final two years in the Air Force. Our dog, Chance, also enjoyed his time in Europe and was the focus of most of our travel pictures.

Several people have asked what my favorite aircraft to fly was and I've said that each had its own special qualities. The C-141 was great for long-distance travel; the C-130J was fun to fly, the F-16 was like driving a Porsche in the air, and the F-15E was the ultimate airplane combining power, performance, and a video game all into one.

Although we don't officiate bike races anymore, my wife and I are thoroughly enjoying our Peloton bike, which will come in very handy in the Grand Forks winters. I'm also an avid reader but my interests have shifted from science fiction as I was growing up to more history and leadership books today. I love teaching and sharing my passion for airplanes. We now have two younger dogs and looking forward to bringing them up to North Dakota.

My experiences across my Air Force career and then at Kent State University led me to apply to this position. I had been familiar with UND from when I was the Chief Scientist at the Air Force Academy due to some partnerships we had then. The Odegard School is a great combination of faculty, staff, and students across many disciplines in Aerospace Sciences and I see significant growth opportunities in the unmanned systems and space studies areas. We are also working to collaborate growth across all four departments with other colleges to synergize our investments and partnerships. With both in-resident and online courses and programs, we will become the first place people consider attending, partnering, or supporting Aerospace Sciences.





Photo by Mike Hess/UND Today.

BRINGING TOWN AND GOWN TOGETHER

A conversational format

A collaboration between the Greater Grand Forks Chamber and UND, Wake Up to UND is an annual event that usually involves a 400-person breakfast. But COVID ruled out that possibility this year, so UND and The Chamber developed an event meant to be both meaningful and different.

“Unlike previous years, in which the president and other members of the University leadership team made presentations, this year’s event was designed with more of a conversational format,” said Fred Wittmann, UND’s director of ceremonies and University events.

“And with the theme of ‘New Faces. New Places’ that we adopted, we knew this would be a great opportunity to have the new UND president and new Grand Forks mayor talk about their collaborative spirit and shared goals.”

The leaders’ conversation – moderated by Meloney Linder, UND’s vice president for marketing and communications – took place in the UND Aerospace school’s TV studio. The lights, cameras and action made this year’s event feel brand new, and that was the point, Wittmann said.

“Instead of just modifying the event, we kind of started over. We looked for a new format that would help us get the message across, and this one worked well.”

Armacost started the conversation by saying what a pleasure it has been for him and his wife, Kathy, to settle in Grand Forks.

“The welcome we’ve received has been enthusiastic and warm – even if it’s been from a six-foot distance,” he said with a smile.

Moreover, “there’s a real sense of excitement and newness across the campus and in the community.” That’s true on University Avenue and in downtown Grand Forks, two places where extensive new construction is taking place.

“We know from experience that the physical appearance of our campus and community is important,” Armacost said. “When students and their families visit us and they feel that collegiate spirit, it has a positive impact on enrollment.”

Bochenski agreed, adding that the civic warmth which the Armacosts have experienced also drew him to Grand Forks.

“This is a very family-friendly community, and it’s a safe and welcoming place,” he said. “Your kids can walk to the park four blocks away and you don’t have any worries. You just know they’re going to enjoy themselves and come back.”

— Tom Dennis / UND Today

CELEBRATE SUCCESS

2020

200

2020 graduates

201

graduate students

2,000

undergrad students

2,000+

visitors on Community Day

500,000+

SkyCam views

June 18th 2020

#1

busiest airport

86,991

hours of flight training

669,291

gallons of fuel

1090

total ratings

643

pilot certifications

1

new weather station installed:
Oakville Prairie Observatory



1

new student organization:
Organization of Black
Aerospace Professionals

\$449,000

given in scholarships

\$12,685,577.49

given in research awards



UND CHAPTER ORGANIZATION OF BLACK AEROSPACE PROFESSIONALS

New chapter strives to help members share aspirations, challenges and achievements

In 1988, long before Eric Poole became an airline captain and assistant chief pilot for JetBlue, he was the only Black student enrolled in his aviation courses at UND.

No one in his circle of non-aerospace friends “knew aviation,” he said. And looking back, he said, that lack of professional peers at the time was his biggest obstacle in becoming a pilot.

Once he became an instructor, he met Eric Scott, a student who’d come to the United States with English as a second language and a dream of becoming a pilot.

Things changed for both Poole and Scott when they partnered through flight. As their friendship grew, they realized how important it was to not only seek help when needed, but to help others in need, and to share in challenges, successes and everything in between – especially as minorities entering a predominantly white profession.

Today, both Poole and Scott have been flying for JetBlue for more than 15 years. Their shared dream has endured across the nearly 30 years since they met, carrying them through many ups and downs.

Such was the message the pilots brought to the Oct. 20 launch event for the newly established UND chapter of the Organization of Black Aerospace Professionals (OBAP). Both of the pilots have been longtime members.

The organization, founded in 1976, is a nonprofit dedicated to creating an inclusive environment for the development of minority aerospace students and professionals.

A group of UND student founders, along with Odegard School administrators and faculty, hosted the two captains and national representatives of OBAP for a Zoom session, celebrating the occasion.

Sharing aspirations for growth and success

UND’s OBAP Chapter President, Jordon-Elijah Apienti-Gyapong, a commercial aviation major, said that the idea to create the chapter started before the coronavirus pandemic struck. Then it was reignited in the wake of George Floyd’s killing in Minneapolis, and the social justice movement that has since swept the globe.

“One student created a group chat, in which there were three of us. Then it became

six. Now there are about 25 students connected in that chat,” he said. “Over the summer we got passionate and started bringing the chapter idea back to life. I want to thank everybody offering their support.”

The founding group of students are enrolled in majors across UND Aerospace.

Their faculty advisor, Assistant Professor Daniel Kwasi Adjekum, said that regardless of one’s major at the John D. Odegard School of Aerospace Sciences, being part of OBAP is about sharing aspirations for success and growth as professionals.

Adjekum’s role as an advisor is to share his experiences and competencies, he said, as well as to encourage group members to celebrate with a communal spirit each other’s contributions and achievements.

“If one succeeds, it is for all of us,” Adjekum said. “Thank you for teaming together and being part of this. And with the support of our College leadership, deans and chairs, we know that we are going to have a positive impact at UND.”

Unforgettable bonds

Sharing success, as encouraged by the aviation professor, was something both Poole and Scott mentioned when asked about how they got to their current positions as seasoned pilots with JetBlue.

“Part of my story with Eric is that we’ve celebrated each other’s successes and helped each other get to these positions that we have,” Poole said. “This is profound, and it’s something important for students to learn: when you celebrate others’ success, you feel that success too.”

After Scott finished his education at UND, the two pilots took slightly different paths. Poole went on to serve in the U.S. Navy, while Scott went to the regional airlines.

By the time Poole’s Navy service was finished, Scott was already at JetBlue and was instrumental in Poole’s hiring as a pilot there. Years later, in other words, Poole’s mentorship on the UND runways had been reciprocated.

“Once you have a bond like that, it’s never forgotten,” Scott said.



Pictured (Left to Right): Delanté Sykes, Joshua Carter, Salah Hassan, Gabriella Danyo, Jaedon Hinds, Betty Thomas, Kevin Musemakweli, Devin Durant, and Alexandre Cyusa.

The two pilots also fielded questions from the chapter president about the cyclical ups and downs of the aviation industry, balancing work and family, and the racial and cultural demographics of aviation.

As a senior officer at JetBlue, Poole said the company is looking inward to identify strengths, as well as shortcomings. Along with other minority professional associations, the Organization of Black Aerospace Professionals is a key group that's helping the industry diversify and improve equity, he said.

For example, Scott pointed to OBAP as an important avenue by which airlines reach out to minority communities. The organization helps its members refine their resumes and connect with employment opportunities across the aerospace industry.

"People are proud of us when they see us in uniform," Scott said. "I've had so many kids come up and ask if I was in the military, as in people don't know that you can go to college to become a pilot. We need to keep promoting our career as a possibility for young people."

Despite his years of experience in the cockpit, Poole still gets double-takes from people boarding flights.

"As more pilots of color are involved, some of those things will go away," Poole said. "The big ask for our pilot group, especially pilots of color, is for them to be present, to be available and to recognize the amount of influence they have in their

personal orbit. They are ambassadors of the profession."

Efforts appreciated, commended

Former Dean Paul Lindseth and OBAP leaders commended the new chapter's members for their work in coming together as students and professionals.

"This is something that has the full support of the Dean's Office," said Lindseth. "Congratulations to the organization, and we appreciate your efforts."

Titus Sanders, the Midwest director for OBAP, remembered the exact date that Apienti-Gyapong reached out to establish a chapter: June 23. He, too, congratulated the students, as well as the faculty for supporting the new group.

"To the collegiate chapter, this is your first step in OBAP, and we hope you continue on through our professional development program," said Sanders of the services available through the organization.

"This is a family, and this is a network full of resources, please get everything out of it that you can," advised David Taylor, a collegiate board member for the organization. "We're here to help you work with chapters across the country, and I'm just excited for everyone who has been working hard to get this started."

UND's chapter of the Organization of Black Aerospace Professionals can be found across social media, @UND_OBAP.

—Connor Murphy / UND Today



UND & AEROSPACE OPEN HOUSE

Prospective students & their families

- Tour campus with current students
- Attend academic sessions presented by the individual colleges
- Visit a residence hall
- Learn what it's like to be a UND student from current students
- Get questions answered by an Admissions representative

We are grateful for our student ambassadors who have shared their enthusiasm for the College of Aerospace during the pandemic. With their commitment, we have been able to continue to showcase our facilities and all that we have to offer our future students.

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UND.EDU/ADMISSIONS/VISIT/



**CHECK OUT OUR VIRTUAL
TOUR ON YOUTUBE!**



KEEP UP WITH THE

PIPER AMBASSADORS

@capt.jordon

@michael.trost

@hunter.roehrig

@carlyshukiar

FOLLOW THE PIPER BRAND AMBASSADORS ON INSTAGRAM FOR EXCITING BEHIND-THE-SCENES CONTENT ON WHAT IT'S LIKE TO BE A STUDENT FLYING PIPER AIRCRAFT AT UND

1988 VS 2020

LIKE MOTHER LIKE DAUGHTER



College is a time full of excitement, learning, and unknowns. For most, attending college is the first time away from parents and the chance to live in a new town. However, for some, your new university might not be so new to your family. This is the case for freshman Julianne Lore and her mother Kris.

Kris' time at UND as a Commercial Aviation student and then later on as an Air Traffic Management double major. Her time began at UND in 1988. After earning her CFI, she took a semester off to work at US Space Camp in Huntsville, Alabama as a counselor and lecturer. While working for a fixed based operator, she had the opportunity to build hours and spend time flying a variety of aircraft. It was during this time flying outside of UND that Kris experienced an in-flight emergency that ultimately changed the direction of her career in aviation.

“...if it weren’t for the controller and the superior training I received at UND, I would not be here today.”

KRISTIANNE LORE '94

While flying late one evening, outside of Washington D.C, the prop on the aircraft she was operating split due to a manufacturing error. The vibrations from the split prop caused the oil seal in the prop hub to break, resulting in a loss of visibility. Several other key systems failed including a full loss of communications. She quickly shut down the engine and began an emergency descent into a small uncontrolled airport. With no visibility, she lost sight of the runway and was forced to plan an emergency landing on a nearby highway. As she was lining herself up to land on the busy highway, she suddenly was able to relocate the airport as the runway light intensity cycled from high to low intensity. It was the quick thinking of the air traffic controller, observing that she was drifting away from the runway, who instructed another aircraft to change the runway light intensity so that she could locate the airport. While I was speaking with Kris on the phone, she said that all of the training from UND “just kicked in” and “if it weren’t for the controller and the superior training I received at UND, I would not be here today.”

After that experience, Kris returned to UND where she added Air Traffic Management as a second major. Kris was involved in many aviation student



organizations, including the flying team. Additionally, with help from the amazing air traffic faculty, she founded the Student Air Traffic Controllers Association, also known as SATCA. She said she was thrilled to find out that SATCA is still an active student organization at UND and that it continues to further aviation safety, awareness, and education. Kris continued to fly recreationally after graduation as she worked as an air traffic controller in several tower and radar facilities before entering Management. She is currently working as the Air Traffic Manager for Toledo Tower. Fast forward to 2021, Kris's daughter Julianne is a freshman in the commercial aviation program preparing to take 102 this spring semester as well as pursuing a minor in sustainability.

During our phone call, Julianne expressed that UND was an easy choice for her. She has grown up going to air shows and hearing about her mother's time as a pilot, and felt that UND was the place for her. As a freshman, she has interest in joining clubs and organizations as well as hopefully becoming a part of a pathway program and eventually flying for a commercial airline.

As I listened to Kris recount her experience in an emergency situation, I found myself feeling grateful that UND aerospace places emphasis on safety and preparedness. Though it is my hope that no pilot ever finds themselves in an emergency, I am comforted knowing that if it were ever to happen I have the skills and training to handle the situation. Thank you very much to Kris and Julianne for taking the time to speak with me and share their stories. Best of luck to every student this semester, and remember, thank your air traffic controllers.

—Elizabeth Mislán / Aerospace Success Center

PROPELLED TO THE TOP

An interview with Captain Katharine Pullis '02



Scrolling through my favorite female aviators group on Facebook, I came across an article announcing Captain Katharine Pullis as Alaska Airlines' first ever female chief pilot at their San Francisco base. As an aspiring pilot finishing up my Certified Flight Instructor certificate at UND Aerospace, with ambitions to enter the professional aviation workforce, I was immediately inspired by Captain Pullis' incredible story of determination and authenticity, propelling her to the top of her field. Imagine my excitement when I read the next paragraph and saw that she is a Commercial Aviation graduate of UND Aerospace! Since graduating from UND, Captain Pullis has used her UND Aerospace background to guide her path to Alaska Airlines. I had the privilege of interviewing her personally to hear her story.

Captain Pullis began by explaining how she reached her current position of chief pilot. She traveled to UND from Hawaii to pursue her dream of flying professionally. After finishing her degree, she found herself instructing in Houston, Texas with her husband Ryan, also a UND graduate, and time building until she was able to get hired at a regional airline. She flew numerous aircraft, from the Embraer 175 to the Boeing 737, until eventually she ended up at Virgin America. She quickly moved up the ranks in the training department, instructing numerous first officers and captains as a Check Airman and Aircrew Program Designee. Then, Virgin and Alaska Airlines merged, bringing her to her current airline. She earned the Chief Pilot position recently as a result of an exemplary training record and high marks from her coworkers and superiors.



When I asked Captain Pullis what the most rewarding part of her aviation career was thus far, her answer was simple--earning the respect of her coworkers and trainees. Captain Pullis is an example of a woman who has succeeded by being her most authentic self and treating others with respect. Seeing such an accomplished and genuine woman place such heavy importance on these traits serves as a compelling reminder to remain focused on your craft, while not forgetting to value others and prioritize kindness.

Additionally, the most challenging part of her journey in aviation has been balancing her successful flying career with her other greatest accomplishment--being a wife and mother to her two children. Captain Pullis constantly must ask the question of "how can I be home for my girls?" with her husband. In a two-airline-pilot household, scheduling around family can be tough, but they succeed and give their daughters two incredible role models to look up to.

Captain Pullis is no stranger to being a role model to others. Due to her strong work ethic, exemplary reputation among peers and superiors, and positive attitude, Captain Pullis will often find herself in the spotlight. Her main goal when interacting with others is to develop mutual trust and help them to learn in an environment free of aggression or condescension. She's seen impressive results by practicing kindness in and outside of the airplane, which is a likely contributor to where she is today.

She credits her swift progress to the background of flight training she received at

UND Aerospace. The training style directly mirrors that of an airline environment, and provides a strong base to build upon once you arrive at the professional level. Hearing this as a student and young pilot myself is encouraging, knowing that the hard work my peers and I are putting in now will certainly show itself later. It is evident that a degree from a large 141 school has an impact on an airline's view of a potential candidate. The basic stick and rudder skills and decision making strategies developed early on are what shape a pilot from a nervous student into a confident, professional aviator. Captain Pullis says there is truly no better place to learn these building blocks from than a school such as UND Aerospace.

Our interview concluded with words of encouragement to "be a human, not an ego." In the aviation industry, it is often too easy to get caught up in others' progress, rather than focusing on the goals of your own individual journey. Staying focused on personal success and tuning out the comparisons around you has proven to be a successful way of thinking for Captain Pullis. These are the words of a true professional who is an expert in her field, and I'll hold this advice close to my heart for the remainder of my career. Captain Pullis is a class act, a true example of a leader and great aviator, and one of the most prominent examples of the best qualities found in a UND graduate.

—Carly Shukiar / Aerospace Success Center



HOW UND BLAZED THE TRAIL FOR UAS

Across nearly two decades, UND research built foundations for local, national and international UAS activity

Image courtesy of Vantis/Northern Plains UAS Test Site.

“Mr. Watson, come here. I want to see you.”

With those words on March 10, 1876, Alexander Graham Bell made the first phone call, summoning his assistant from the next room — and starting the world’s telecommunications revolution.

One day, when drone deliveries of groceries are routine and drone taxis zip travelers between rural airports and skyscraper downtowns, historians will look for a similar origin story for the civilian use of unmanned aerial systems (UAS). They might find what they’re looking for in the classrooms, offices and simulators of UND.

Because that fantastic future of shared airspace had to start somewhere. And researchers at UND were among the first to imagine that future and start to make it come about.

The 14th Annual UAS Summit & Expo featured the announcement that North Dakota will be the home of Vantis, America’s first statewide UAS beyond visual line of sight (BVLOS) network.

Vantis will enable UAS applications known now and yet to be conceived — from package and medical delivery to utility inspections, search and rescue operations, and agricultural uses. It’s a major development on the world’s path to unmanned air taxis and even more futuristic uses of UAS.

And in talking about Vantis, Nick Flom, executive director for Vantis’ managing entity, the Northern Plains UAS Test Site, gives great credit to UND.

UND and the UAS ecosystem it helped develop were instrumental in securing \$28 million in support from the North Dakota Legislature in 2019 for the BVLOS network’s development, Flom said.

“UND has built up some really smart people in this arena that have allowed us, the Test Site, to be at the peak of our game in order to make something like Vantis work,” he said.

“We’re able to do this in North Dakota because of UND’s history of research on this subject.”

Primed to answer the call

Of course, the history of North Dakota’s UAS ecosystem and its all-in focus on BVLOS goes back a lot longer than 2019.

“We started working on detect-and-avoid challenges in about 2007 or 2008,” said Mark Askelson, executive director of the UND Research Institute for Autonomous Systems and Associate Dean of Research in the John D. Odegard School of Aerospace Sciences, at the recent summit. Askelson was referring to the technology UAS operators use to prevent mid-air collisions.

“The U.S. Department of Defense had a number of locations in the United States where they wanted to fly missions beyond visual line of sight, but they couldn’t do it,” he said.

That’s because the national airspace isn’t like that of a warzone, where the Department of Defense (DoD) can manage the airspace however it wants, explained

Askelson. Federal Aviation Administration (FAA) rules allow private citizens to fly at their leisure, without a need to broadcast their location. These types of flyers – planes, gliders, balloons, birds or otherwise – are regarded as “non-cooperative.”

In order to make airspace viable for domestic drone use, the DoD needed to create solutions for detecting non-cooperative aircraft without restricting flight.

UND, with its nationally renowned flight school and regular FAA partnership in matters of flight safety and research, was the right place at the right time with the research tools to meet the DoD and FAA’s challenge.

“The reason university research matters is because we’re solving problems people need solved,” Askelson said. “We wouldn’t be where we are today without a lot of different things and contributors, but research has been a key part of that.”



Bedrock research for UAS ecosystem

At UND, Associate Professor of Aviation Ben Trapnell’s experience was vital in the University’s starting to meet the DoD’s original challenge.

Back in his days as a student at the U.S. Naval Academy and as a naval aviator, Trapnell studied phased array radars. He learned how accurately they could surveil surrounding airspace from the ground, and that their capabilities had improved to where they could spot objects as small as birds.

Once at UND, Trapnell heard of work others were doing with the same radars on a tornado-prediction project at the University of Oklahoma. Their idea of mounting phased array radars on cell phone towers gave him the idea that such technology might provide an additional function: detect-and-avoid. Soon, representatives of an Air Force program called UAV Battlelab were coming to UND, having learned from Trapnell and others about the BVLOS potential of the University’s experience with phased array radar.

Then-U.S. Sen. Byron Dorgan, D-N.D., was instrumental in creating this federal connection to UND. Dorgan secured the funding for UAS-related research, through UAV Battlelab, that is the bedrock for the UAS ecosystem North Dakota has today.

UND and its partners’ BVLOS research settled on a two-pronged approach. The first involved building a network of phased array radars.

Forming a triangle with these radars, 40 miles to a side, was the foundational idea behind GPAR-RMS – the Ganged Phased Array Radar Risk Management System –

the first ground-based detect-and-avoid system for UAS.

The radars on the three corners could constantly scan. If one radar was needed to track a potential hazard, the other two could provide the redundancy needed to ensure a clear flight path for a UAS.

Cross-campus collaborations to find solutions

But a ground-based array wasn’t enough, especially for the job of enabling unmanned aircraft to avoid potential hazards autonomously – that is, without direction from a controller.

For that task, an onboard system was required. Fortunately, UND engineers once again proved up to the challenge.

Researchers at the UND College of Engineering & Mines worked on a payload solution incorporating highly specialized transponders.

Essentially, the radar array architecture developed in Aerospace addressed the BVLOS flight question, while the payload solutions developed in Engineering enhanced safety by enabling autonomous calculations and course corrections.

With an operational radar array that could provide guidance to operators, and a detect-and-avoid payload for UAS that could take autonomous action if necessary, UND had developed patentable ideas. Two UND patents were secured and licensed for the overall detect-and-avoid system architecture (GPAR-RMS) and the transponder-based payload solution.

Along with detect-and-avoid technology, UND advanced Automatic Dependent Surveillance-Broadcast or ADS-B technology – technology by which an aircraft broadcasts its position, altitude and velocity every second. This application of ADS-B demonstrated the benefit of cooperative data in creating shared airspace, said Askelson in a recent interview with UND Today.

Throughout the 2010s, ADS-B transponders became a standard in general aviation worldwide. In fact, as of January 2020, all aircraft flying in the United States above 10,000 feet (more technically: Classes A, B, C and E airspace) are required to carry such transponders.

Meanwhile, at UND, “we were executing flight tests around 2009 where we were testing with simulated intruders, and the aircraft was detecting and avoiding them, using ADS-B-based technology, autonomously,” Askelson said. “That was a big deal.”

The Mitre Corp. agreed. The nonprofit, federally funded R&D company – whose work helped create the national airspace as it’s known today – was impressed by how UND harnessed the ADS-B technology first developed by Mitre. This interaction set the stage for UND’s continued role in BVLOS work.

Milestone for North Dakota airspace

The Limited Deployment – Cooperative Airspace Project (LD-CAP) was that next step. Backed by state funding, UND partnered with Mitre and the NASA-Langley Research Center to integrate detect-and-avoid algorithms onboard NASA aircraft.

Besides generating another round of valuable research at UND, the NASA project also brought about a significant outreach effort.

In cooperation with the North Dakota Aeronautics Commission, UND procured a number of ADS-B units to provide to pilots flying regularly in the state. Thus, UND

developed an awareness campaign to educate pilots on the systems' benefits and create a friendlier airspace in North Dakota for UAS integration.

Speaking with UND Today, Flom called this a milestone development.

"In North Dakota, most general aviators are flying below 10,000 feet. So, until relatively recently, there wasn't much motivation to equip with ADS-B," Flom said.

Having those previously non-cooperative aircraft broadcasting their location was a win for drone integration.

"The fact that LD-CAP helped equip the state's fleet – meaning private owners – through subsidies and programs made us the most cooperative state in the country for ADS-B traffic," Flom said. "That's incredible."

The steps following LD-CAP further refined UND's inventions. In particular, UND's work helped set the stage for Vantis: a latticework of radars and other detection gear, much of it installed on existing infrastructure such as cell-phone towers, that will provide airspace surveillance and sophisticated radio communications to UAS operators and researchers.

What was once confined to a 40-miles-on-a-side triangle will be able to span an entire state.

Research revolutionizing tech, right here at UND

Summarizing his thoughts on how UND was able to make the most of its UAS opportunities, Askelson said he was sure of one thing.

"This started with people in our ecosystem recognizing the industry's importance," he said, naming UND Aerospace past deans Bruce Smith and Paul Lindseth, respectively.

"Our leaders at UND, in Bismarck and in Washington coalesced around unmanned aircraft. They set out a strategy of opening opportunity sets for us both at the state and federal level."

State efforts such as the Research ND Grant Program, the 2006 designation of UND's UAS work as a North Dakota Center of Excellence and the push to sponsor and stand up the Northern Plains UAS Test Site, were vital.

And, with respect to the FAA and its position on UAS integration, things have come a long way.

"Looking at where we are now, the FAA is an active partner in trying to solve these problems," Askelson explained. "Going from 2005 to today, where we now have test sites, the Integration Pilot Program and the ASSURE research program – it's really evolved."

Research efforts at UND helped make beyond visual line of sight operations for unmanned aerial systems possible. It's a story of generating expertise through fundamental research and then expanding discovery through focusing on a new set of challenges – UAS BVLOS, detect-and-avoid, integration into the national airspace and, more broadly, autonomy.

Nearly two decades in the making, UND faculty and students, in collaboration with state, federal and industry partners, used the power of research innovation to build the foundation for Vantis and the ensuing vast commercial activity it will support in North Dakota and beyond.

So, when historians pore through emails and hard drives in search of the beginning of this revolutionary technology, they may – as happened with the Bell story – distill many careers and layers of innovation into a representative moment.

Chances are good that they'll situate the moment at UND. Because at the dawn of the industry, many of the smartest and most capable UAS-minded people were right here.

—Connor Murphy / UND Today

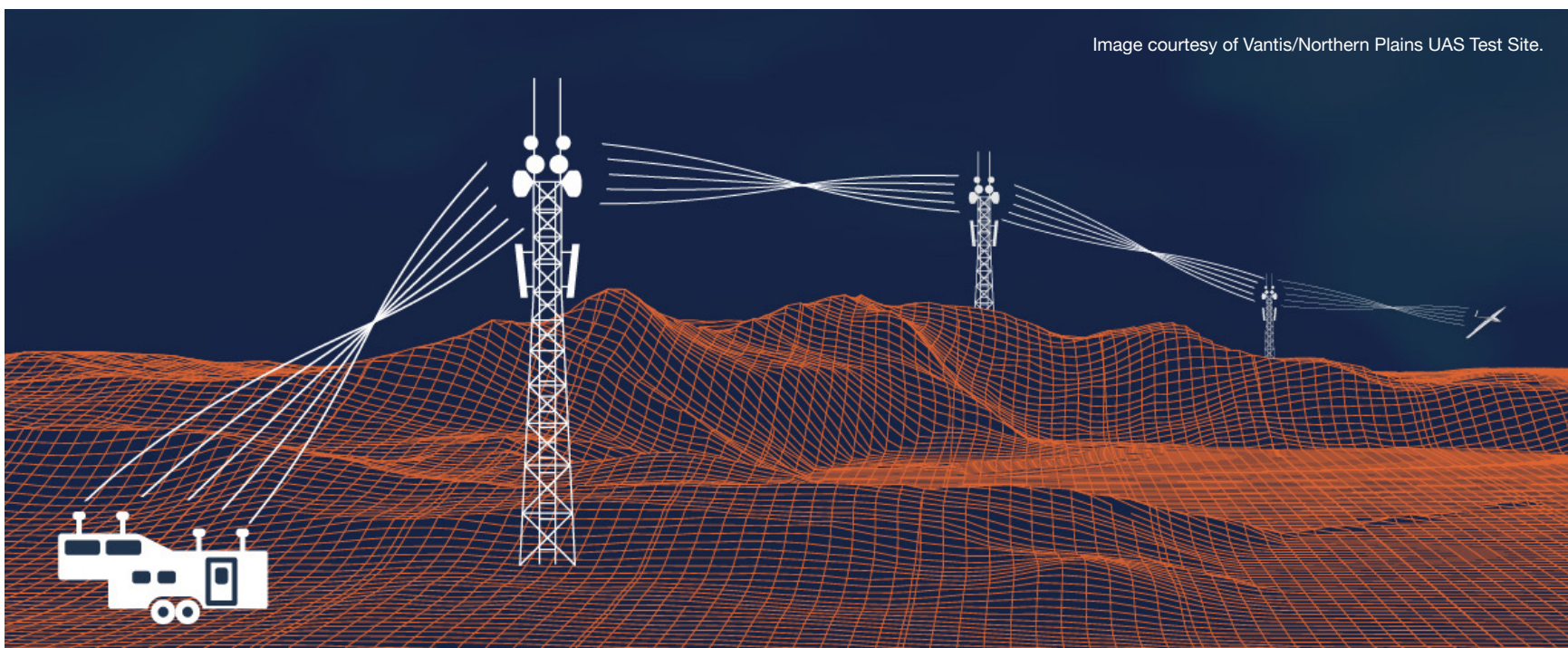


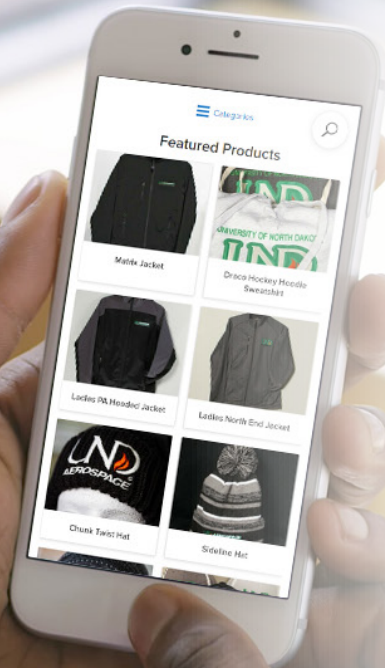
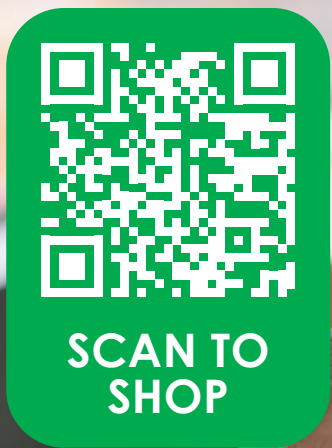
Image courtesy of Vantis/Northern Plains UAS Test Site.



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SNOWFLAKES IN FLIGHT

New instrument paves the way for better understanding of winter weather.

Snowflakes are a tale of contrast. Individually, they represent one of nature's most intricate creations. Delicate and detailed, they invoke a sense of tranquility as they peacefully fall to the ground. En masse, juxtaposed with the harsh, cold winds of the region, a different story is told. Blizzards can result as millions of snowflakes are shattered. They sting on contact and bring travel to a standstill due to reduced visibility, representing the worst of what nature can offer.

While some shelter in place, I thrive in these conditions. Research questions fill my mind while I venture into whiteout conditions. I created a research program that tackles various aspects of blizzards and blowing snow events, but one question is outstanding in its difficulty: How does one obtain direct observations in a blizzard?

Such a question is a key topic of my research project funded by the National Science Foundation. Observations like the size, shape, and number of snowflakes underpin any model we develop. Currently available instruments to measure these properties can tally into the hundreds of thousands of dollars. As a result, observations are few and far between. This led me to start from scratch and build my own system for imaging snowflakes.

I'm not new to building and tinkering with things. In the late 90s, I built a computer to play mp3s in my car, far outclassing the 6-disk changers that were available at the time. But that quickly became a relic with then the iPod was released a few years later. For this project, I relied heavily on my experiences as a photographer. 'Freezing' snowflakes in motion takes a system capable of flashing for a period of microseconds (faster than a lightning strike!). The solution rested in the use of an affordable LED strobe light paired with a small computer and industrial camera. While connecting parts together is usually an expensive barrier for instrument development, I rolled up my sleeves and designed custom, 3D printed parts. The result is a system that is orders of magnitude cheaper than commercial options.

Despite being experimental, the system has been a resounding success. We already have 100+ hours of images from the past year, ranging from mixed precipitation events, to snowstorms, to blizzards. In the spirit of bringing research to the classroom, images are being used in the classroom to augment lectures, and manual classification of snowflakes is the subject of a current senior capstone project. Even further, the first publication is currently in the works, and data from the instrument are being used to identify errors with another instrument.

So what's next? Just because the system works, doesn't mean it's finished. I've been busy refining various components and releasing the plans as 'open' hardware. While there is a place for commercialization of technology, my main goal was to make the instrument simple and affordable enough that any educator or researcher can build it. It's my hope we can create a community around it so we can improve, support, and learn from each other. In the end, this will speed science including the development and improvement of our weather models. I also want to adapt the system to eventually fly on UAS platforms. This would fill a data void region of the atmosphere where it is simply too dangerous for manned aircraft to fly.

—Aaron Kennedy / Atmospheric Sciences Associate Professor

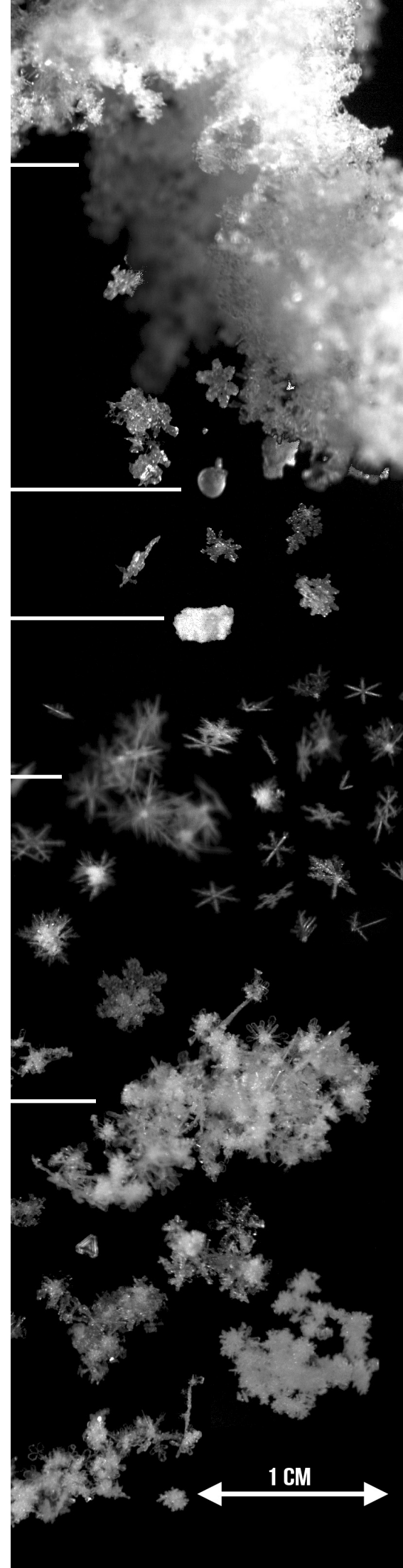
Largest snowflakes
April 5, 2020
at least 1.6" = 4 cm

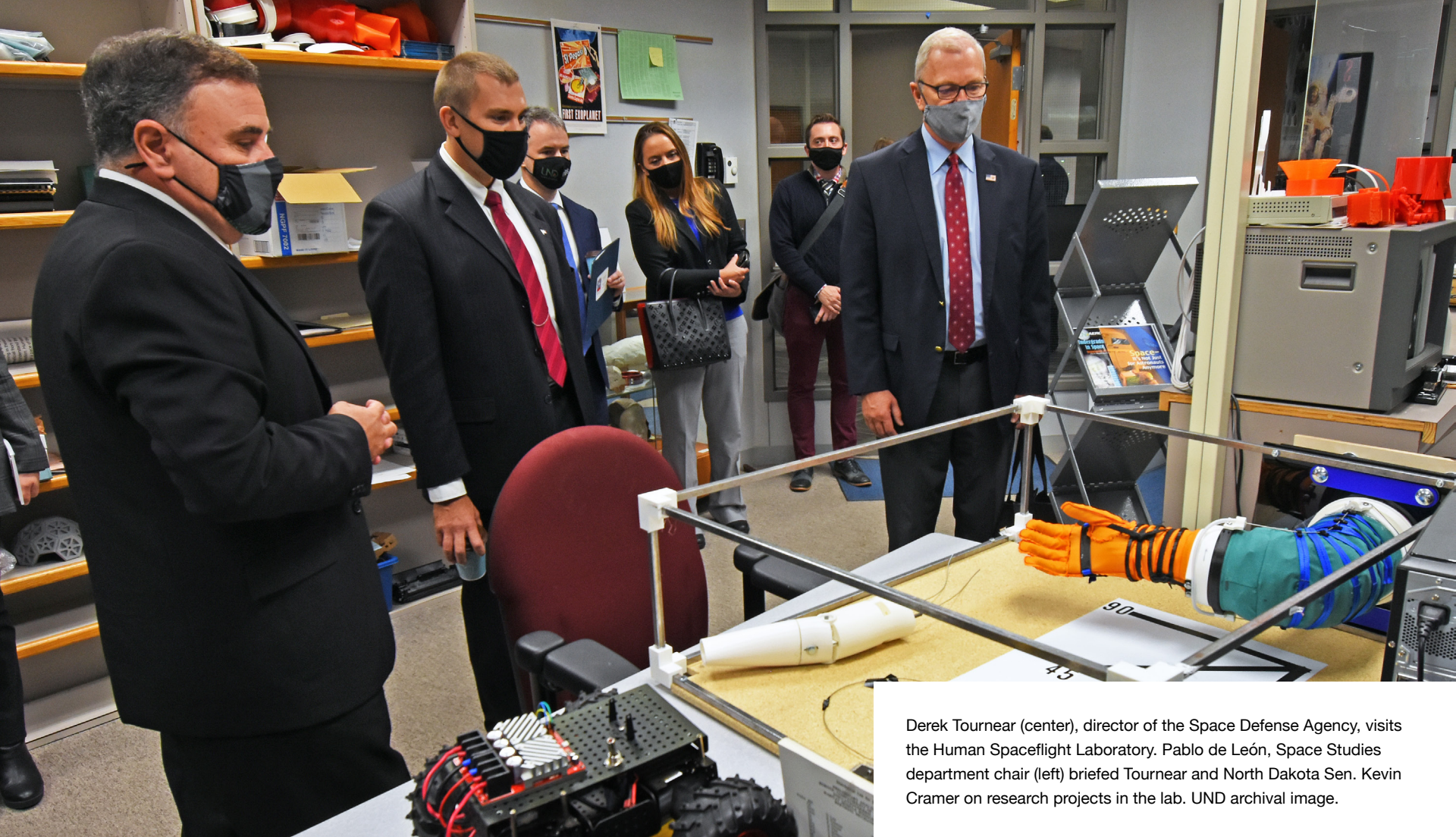
Frozen rain drops and
rimed snowflakes
April 2, 2020

Graupel

Dendrites
December 15, 2020

Aggregates
December 28-29, 2019





Derek Tournear (center), director of the Space Defense Agency, visits the Human Spaceflight Laboratory. Pablo de León, Space Studies department chair (left) briefed Tournear and North Dakota Sen. Kevin Cramer on research projects in the lab. UND archival image.

UND RESEARCH AND NORTH DAKOTA: SPACE & NATIONAL SECURITY

Just as North Dakota has become a UAS hub, so, too, can it become a center for space and national security research, UND leaders say

Editor's note: *In the special issue for UND Today, they highlighted the statewide impact of UND researchers and research. They published roundups on five key North Dakota topics, including Rural Health, Autonomous Systems and Western North Dakota. Then in each roundup, they listed and linked to recent UND Today pieces that show how the University's work is affecting that topic.*

This story: Space & National Security

As every UND aerospace student knows, John Odegard pioneered UND's aviation program with two donated aircraft. The Odegard School of Aerospace Sciences today operates one of the largest fleets of civilian aircraft in North America and is known worldwide for its aviation-industry training programs.

Now, we can expect eyes at the school to be turned even further skyward, if recent

developments are any indication. That's because a parade of high-level visitors to UND over the past year is pointing to very high-flying things to come.

"It's a critical and exciting time to be in the space business," said Gen. John W. "Jay" Raymond, U.S. Space Force commander, during his January 2020 visit to UND.

"There is a lot of great research going on; there's a Space Studies program here. As we develop future Space officers, I think this school has a great opportunity."

Raymond's visit was documented in a UND Today story, *Leader of newly formed Space Force visits UND*. A few months earlier, as UND positioned for future space exploration reported, NASA administrator Jim Bridenstine had visited.

“The University of North Dakota is delivering — on behalf of NASA — technology that is helping us understand the earth, helping us understand the earth’s atmosphere, helping us better predict weather events and the climate,” Bridenstine said during his visit. “Beyond that, the University of North Dakota is helping us with human space flight.”

September brought a visit by Gen. James Dickinson, the new commander of the U.S. Space Command. As described in *To North Dakota and beyond*, Dickinson liked what he saw: “I will tell you those young cadets coming through the university here – soon to be officers – we will absolutely look to those types of individuals to be part of not only the U.S. Space Force, but what I’m responsible for, which is the United States Space Command,” he said.

Then in October came the director of the U.S. Space Development Agency, Derek Tournear. Tournear, too, “was upbeat about the potential role the University and the surrounding unmanned aircraft systems ecosystem could play in developing a national space defense system,” reported the *UND Today* story, *UND experts could drive satellite defense system*.

These leaders visited UND for the same reason that John Odegard’s original idea gained such strong support: space in 2021, like aviation in 1968, represents a growth opportunity and a chance to further diversify North Dakota’s economy.

“I’ve quipped that I’d like us to launch satellites from Grand Forks, but please don’t take that literally,” *UND President Andy Armacost* said in his Oct. 27 message to campus. “A more practical goal is to design, build and control satellites after they’re launched into orbit elsewhere aboard a commercial space vehicle.”

That’s not an impossible dream, nor is it unrealistic for *UND* to pursue an invaluable Department of Defense designation as a University Affiliated Research Center. “Consider all the work we can do at *UND* with our air-based autonomous systems to test technologies and procedures for future systems operating autonomously in space,” he said.

“There’s a promising frontier right in front of us. Let’s use the creative and scholarly talent of our faculty, students, and staff to make some magic happen.”

Pablo de León, Professor and Chair of *UND*’s Department of Space Studies, already is doing that and more. Thanks to de León’s leadership, “the spacesuits of the future are being designed at the University of North Dakota, in the Human Spaceflight Laboratory,” as *UND* teams with NASA for paradigm shift in space exploration describes.

Also thanks to de León and as noted in the above story, the department’s Lunar/Mars Inflatable Habitat, located on the edge of the *UND* campus, “regularly trains future space explorers and informs *UND* researchers on the challenges and isolation of prolonged living and working in space.”

One such mission brought four students from Argentina, Colombia, Mexico and Peru to the Inflatable Habitat, where they spent two weeks running experiments to help NASA with exploring the moon and Mars. “It’s one of the greatest habitats that I’ve ever been in,” said Mission Commander Danton Bazaldua, an engineering student at the National Autonomous University of Mexico, in the October 2019 *UND Today* story, *Down-to-earth international space exploration*.

National security is another expanding area of focus for *UND*, one that overlaps with the space developments. After all, the U.S. Space Force’s purpose is not to explore space, but to protect America’s assets in space, Gen. Raymond said during his visit.

A few layers down in the atmosphere, the Air Force fulfills its own national security role, and depends in part on universities such as *UND* for research. The work benefits all: For example, as *UND* awarded Air Force ‘Agility Prime’ contracts

explains, *UND*’s role in Air Force’s Agility Prime “flying car” research will not only help the Armed Service, but also further grow North Dakota’s UAS ecosystem, a significant statewide benefit.

And as noted in *UND* to develop augmented reality system for Humvees, published as recently as Jan. 7, *UND* now is bringing its autonomous-technology expertise to ground vehicles – specifically, the Humvee, the iconic tactical vehicle widely used by the U.S. military.

“There’s a promising frontier right in front of us. Let’s use the creative and scholarly talent of our faculty, students, and staff to make some magic happen.”

ANDY ARMACOST, UND PRESIDENT

“We’re proud to have pioneered the development of autonomous technology in aircraft, and we’re thrilled to now be doing the same in ground vehicles,” says Mark Askelson, Executive Director of *UND*’s Research Institute for Autonomous Systems, in the story.

But even more rewarding is the sense of service that the Humvee work is delivering, Askelson continues.

“At the end of the day, what really excites me about this work is us bringing our skill set to bear on problems are facing the Department of Defense,” he says. “We can solve these very real problems that are affecting people in the field. We can help the operators execute their missions with greater safety and more efficiency. And that gets all of us pumped up.”

— Tom Dennis / *UND Today*

UND TEAMS WITH NASA FOR PARADIGM SHIFT IN SPACE EXPLORATION

Space Studies Department's three-year project will focus on developing, manufacturing spacesuits using advanced 3D printing



This conceptual image shows the aims of de León's prototype project. Concept art by Martin Demonte/HSF Lab/UND.

The spacesuits of the future are being designed at the University of North Dakota, in the Human Spaceflight Laboratory.

Pablo de León, Professor and Chair of UND's Department of Space Studies, recently won a NASA grant for \$750,000 to develop a new 3D-printed spacesuit prototype for Mars and beyond. De León is leading a three-year research and development effort to create spacesuits using advanced 3D printing, also known as additive manufacturing.

De León, who also serves as director of the Human Spaceflight Laboratory on UND's campus, has long researched spacesuit technology on behalf of NASA.

The \$750,000 grant was awarded by NASA's Established Program to Stimulate Competitive Research (EPSCoR) as part of the program's \$11 million award to 15 schools and organizations across the country. Each year, NASA EPSCoR distributes funding for research and technology development projects in areas critical to

NASA's mission.

For UND, this is the third such grant that the University has received. Two previous NASA EPSCoR grants supported the development of one of the nation's few livable space habitat systems, located just west of campus.

De León hopes to produce a fully 3D-printed spacesuit that could potentially "change the paradigm" in matters of extended, manned space exploration.

"I'm somewhat going back to my roots of developing spacesuits, and now we're using a completely new system that we developed in the lab," he said. "We devoted the past year to making a lot of improvements in our techniques and methods, and NASA recognized that improvement. Now we are ready for action."

Answering material questions

The "system" to which de León referred is a series of 3D printers capable of

transforming plastics into flexible, durable materials suitable for space.

A fully formed suit would need to be pressurized and resistant to the extreme temperatures and abrasive conditions associated with space travel and planetary exploration.

“Building any portion of a spacesuit takes literally thousands of hours of manual labor by extremely skilled textile workers.”

PABLO DE LEÓN, CHAIR OF SPACE STUDIES



Holding a glove from a conventional spacesuit, de León made the case for 3D printing’s huge potential.

“Building any portion of a spacesuit takes literally thousands of hours of manual labor by extremely skilled textile workers,” de León said, pointing to the latticework of layering and stitching required to keep the glove in one piece. “That’s why a spacesuit ends up being so expensive.”

High-profile, hands-on research

Now funded to pursue the project, de León intends to provide a number of scholarships for students to work with him. So while the Human Spaceflight Laboratory at UND advances the state-of-the-art in space technology, the NASA EPSCoR grant will also provide a workforce development opportunity for UND’s students in the Department of Space Studies, located in the John D. Odegard School of Aerospace Sciences.

Companies and organizations take high interest in students with experience and knowledge beyond theoretical coursework, de León said. The Human Spaceflight Laboratory goes above and beyond in the practical, hands-on experiences it offers.

Graduates of the program have gone on to jobs across the space industry, including places such as NASA, SpaceX and Blue Origin.

“We have applications from students from all over the country to work with us on these new technologies,” he said.

Paul Lindseth, dean of the Odegard School, said he is proud to have de León on the UND Aerospace faculty.

“Dr. de León’s innovative idea of using 3D printing technology for spacesuit development is another example of why Pablo continues to be recognized internationally in this dynamic field,” Lindseth said.

Most of the manufacturing will take place in the lab, according to de León, although NASA’s Marshall Space Flight Center in Alabama is home to the organization’s leading 3D printing experts, who are supervising the UND project. De León also plans to collaborate with UND’s own BiPed Lab, a motion-capture studio that will help the development team compare movement capabilities between conventional and 3D-printed suits.

“At UND, we established ourselves as one of the prime developers of advanced spacesuits, and we’ve done that through the years,” said de León, who has led multiple spacesuit projects on campus. “There are only a handful of places in the country that do what we do. This new award is a demonstration of confidence by NASA in the things we have done before, and the interest in continued development.”

Not only is the expense of manufacturing immense, but also as human spaceflight moves away from Earth, astronauts will need to be able to repair and maintain their spacesuits – perhaps even manufacture pieces – on their own, said de León. The skill and material currently required to create space-worthy garments cannot easily be transferred to outer space.

“We’re trying to build a prototype spacesuit that could eventually be manufactured on Mars, or any other destination, thus cutting the dependence we have on today’s spacesuits,” said de León.

Such manufacturing is regarded by NASA as “in situ resource utilization,” which means finding and using resources on other planets that allow for continued life and potential settlement by humans. While established space settlements are still distant, the material questions being addressed by de León are key to moving forward.

De León then exchanged the conventional glove for a variety of 3D-printed, flexible arm joints and glove digits.

“While 3D printing is still in its infancy, we were able to find a number of materials that, when formulated in the right way, can be used to print flexible plastics,” he said.

—Connor Murphy / UND Today



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