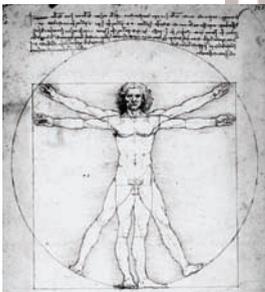


# Mikel Miller

## Science, Service, and Family



**HUMAN  
ENGINEERING**

**I**t has been a long journey to success for Mikel M. Miller, the U.S. Air Force’s lead scientist for positioning, navigation, and timing (PNT) science and technology development.

Now chief scientist in a directorate at the Air Force Research Laboratory (AFRL), at Eglin Air Force Base, Florida, for more than 30 years Miller has researched, developed, tested, integrated, and implemented state-of-the-art guidance, navigation, and control hardware and software systems for the Department of Defense (DoD).

That’s the formal job description.

Miller also leads, motivates, teaches, advises, and mentors other scientists and engineers. Yes, he is people-oriented, a husband and father — and he is a spiritual man. One of his favorite sayings: “I am third. Number One is my relationship with God, Number 2 is my family and other people, and then comes me.”

Despite being last on the list, or perhaps because of it, Miller has managed to do quite well for himself.

“I have the privilege of working with, and serving, the many AFRL and DoD PNT scientists and engineers that constant-

ly strive to achieve our vision of providing every soldier, sailor, marine, and airman with precise, accurate, assured PNT anywhere, anytime, using anything,” he said.

### How it came to be

Miller, the son of an Air Force non-commissioned officer, was born in Sioux City, Iowa, in 1960. He didn’t stay in one area for long because of his father’s service commitment.

Miller’s dad and his twin brother had both dropped out of high school at age 17 in order to enlist in the armed forces. His father’s first assignment was to Germany, where he met Miller’s mother, Barbara. She was the daughter of Maximilian Fleischer, a wealthy and famous news publisher who lost everything when he refused to be a part of Hitler’s propaganda machine.

The Fleischers had spent the war under house arrest, and when Maximilian died, the family survived by selling their belongings on the black market. “When my dad met my mom in Germany in the mid-1950s, she was working in this small-town restaurant. My dad says it was love at first sight,” Miller says.

PETER GUTIERREZ

Among Miller's fondest memories are the trips he took through Germany with his parents and his two brothers and sister. They visited his mother's family in small towns in Bavaria. "We would go hiking through beautiful forests and mountainous areas. I remember great festivals with bumper cars and bratwurst," he recalls.

As an "Air Force brat," over the years Miller's family was stationed in Grand Forks, North Dakota; Otis Air Force Base (AFB), Cape Cod, Massachusetts; Fortuna Air Force Station, North Dakota; Milwaukee, Wisconsin; and at Hahn AFB, Germany.

Mostly a North Dakotan by then, Miller played baseball everywhere he lived. It was to Williston, North Dakota, that his father retired from the Air Force in the late 1970s.

Miller finished high school in North Dakota, excelling in math and science classes —and even had a lead role in a Williston High School Capers play. It was also in high school that Miller met his wife, Colleen, whose name, when he types it, is frequently followed by a smiley face emoticon.

Miller has many great memories growing up on Air Force bases worldwide. Some of his favorites include washing the family cars on Saturdays, playing the video game "Pong" when it first came out, and working in his parent's Bavarian restaurant, when his father retired from the service.

"My parents were very supportive and encouraging. Though neither of them have a college degree, they really hoped that we would go to college," he says. Miller and his older brother, Dennis, went to North Dakota State University, where they both were distinguished graduates and commissioned as Air Force officers through the ROTC program.

The Miller brothers would each go on to receive master of science degrees in electrical engineering from the Air Force Institute of Technology (AFIT). Perhaps most important, Miller says, "My parents taught me people skills and the importance

of valuing everyone you meet — their greatest attribute."

Sorry, did we mention Colleen 😊?

Miller insists that he married "the most amazing woman in the world."

"Colleen and I will be celebrating 34 years of marriage next December. She is the best blessing that has ever happened to me," he says. "Her faith, her love for people and family, and strong desire to serve is second to none, and I wake up every morning feeling so blessed that she is my wife."

After the couple married in 1982, the romance required some initial hard work and determination. The couple overcame the death of Colleen's father in a car accident that also left her older sister, Tracy, seriously injured.

### Preparing to Launch

In spring 1983, as a newlywed and a college graduate, Miller entered active duty at Offutt AFB, Nebraska. There, until 1986, he served as satellite systems engineer and systems integration engineer in the 1000th Satellite Operations Group.

It was in 1986 that Miller's career — and subsequent immersion in GNSS — began to take off as he returned to school at AFIT, Wright-Patterson AFB, Ohio. As a graduate student there, he first learned about GPS in a two-week block of instruction in a Fundamental Navigation Technologies class. The following year, 1987, with M.S. degree in hand, Miller was assigned to the 6585th Test Group, now known as the 746th Test Squadron, at Holloman AFB, New Mexico.

In 1988, Miller was selected to serve as the program manager for all GPS Test and Evaluation (T&E), and over the next three-plus years he managed T&E of DoD GPS receivers used for land, sea, and air applications. He worked closely with the NAVSTAR GPS Joint Program Office (JPO) and was selected by them to serve as the deputy test director for several multi-service T&E programs for the latest state-of-the-art GPS receivers.

"I was responsible for all program

## Compass Points

### GNSS event that most signified to you that GNSS had 'arrived'

Testing of the initial handheld units from vendors such as Trimble's two-channel GPS receiver and Rockwell Collins' PLGR. "We thought, 'What an amazing capability to have a handheld device that all you had to do was turn it on and it told you where you were — wow!'"

### What popular notions about GNSS most annoy you?

Miller believes we take GNSS too much for granted. "Actually," he says, "we are at a point in history where we are as dependent on PNT as we are on communications — it's like oxygen — we [can't live without it]."

### Favorite equation

Mike Miller loves the fundamental Kalman Filter:

$$\hat{x}(t_2) = \hat{x}(t_1) + K(t_2)[z_2 - \hat{x}(t_1)]$$

where

$$K(t_2) = \sigma^2 / (\sigma^2 + \sigma_z^2)$$

### As a consumer, what GNSS product, application, or engineering innovation would you most like to see?

Miller says he's really eager to see "connected cars." "The majority of car accidents are a result of human error," he points out. "Automobiles with auto-assist collision avoidance capabilities and the ability for cars to communicate their position, speed and direction with each other could enable collision avoidance as well, especially in those situations where cars cannot see each other due to visual obstructions and road curves."

### Engineering mentor — not necessarily an engineer

Back in High School in Williston, North Dakota, two teachers made lasting impression on a young Mikel Miller — his math teacher, Mr. Degele, and his chemistry teacher, Mr. Ceglowski. "Both had such a love and passion for their subjects. They taught with such enthusiasm and clarity — it made both subjects mean so much more to me." Later, he says, Dr. Peter Maybeck was probably the most influential mentor in his professional life. "He also had a strong impact in my personal life. The way he treated and interacted with people was his greatest strength and blessing. He had a unique way of making you feel at ease and you always felt like you were the most important person in the room when you were with him."



**NORWEGIAN EXTREME ARTIST, ESKIL RONNINGSBAKKEN, BALANCES WITHOUT SAFETY LINE ON THE 3,200 FEET CLIFF - KJERAGBOLTEN, IN NORWAY.**

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# AMAZING SKILLS OF THE WORLD

INSPIRE US ...



The Miller family: Casey, Colleen, Mikel, Krista, Lauren, Trevor, and Megan.

phases, from planning through program completion, and managed annual budgets totaling more than \$6 million,” he says. In this position, he was responsible for transitioning the GPS JPO’s field test capability from the Yuma Proving Grounds (YPG) in Arizona to the Central Inertial Guidance Test Facility (CIGTF) at Holloman. The goal was to establish a premier GPS field and lab test capability for DoD user equipment.”

JPO wanted to create a tri-service capability, taking advantage of Army and Navy expertise and their capabilities located in different parts of the country. To get the job done, Miller again used his people skills to get the particular services to work together to establish plans on who did what and eliminate duplication of efforts among the various agencies and services. CIGTF also had to transition a world-class inertial sensor/system T&E organization into carrying out the same quality/class of T&E for GPS-based technologies.

The results speak for themselves. The “G” in CIGTF was changed from guidance to GPS, henceforth the Central Inertial and GPS Test Facility. Moreover, in large part due to Miller’s efforts, DoD has a solid foundation in T&E organizations to execute not only GPS but also PNT testing and evaluation

Key test programs undertaken during his time at Holloman included receiver 3A velocity verification tests; precision lightweight GPS receiver (PLGR) field testing in challenging GPS denied/degraded environments, inertial measurement unit (IMU) centrifuge, and sled testing.

In the run-up to the first Gulf War, CIGTF carried out a “quick reaction effort” to develop and produce radar corner reflectors that could be positioned so that aircraft could take a radar position fix and initialize their inertial navigation systems (INS). “This was critical,” Miller explains, “since GPS was not yet operational and many aircraft did not even have GPS receivers.”

The corner reflectors were positioned in a pattern, surveyed using GPS, and their coordinates provided to the pilots and navigators. This gave the aircraft the ability to provide their INS Kalman filters with an accurate position fix and thus tighten up and reduce the inertial drift. CIGTF developed, tested, packaged, and shipped more than 200 corner reflectors to the field in about 30 days, Miller says.

## A GNSS Love Affair

“I fell in love with GNSS when I started testing it at CIGTF Holloman AFB,” he says. Shortly after being assigned to his next position, Miller was asked to put together a short GPS “tutorial” to educate CIGTF personnel, which sparked a desire to go back to school to earn a Ph.D. and teach navigation at the graduate level.

Miller completed his Ph.D. in electrical engineering at AFIT, where his research focused on stochastic estimation, Kalman filtering, and multiple-model adaptive estimation.

Miller then became a professor at AFIT, and with Dr. John Raquet helped to create the institute’s Advanced Navigation Technology (ANT) Center.

“We brought a much more hands-on education environment for students using actual PNT equipment such as inertial instruments, GPS receivers and Alt-Nav devices such as cameras,” he says. “I’m fortunate now to serve as the ANT Center’s Chair for their Distinguished Review Board (DRB), which meets annually to review existing efforts and their plans for the future.”

Since 2003, Miller has worked at the Air Force Research Laboratory, Sensors Directorate (AFRL/Ry), first working to establish an Alt-Nav focus, with emphasis on vision aiding and precise time transfer.

“It has been very difficult to transition any of this technology,” Miller says. The main challenge is that our existing DoD platforms do not have an architecture that allows for an easy integration of this technology into the PNT system — hence my current and, in my opinion, the most important effort of my entire professional career — is the development and fielding of a robust, resilient, and trusted PNT Government Reference Architecture (GRA) . . . that will provide the DoD with a plug-and-play PNT capability.”

As the senior scientist for PNT in the Air Force, Miller’s current focus is on creating the PNT science and technology (S&T) vision and strategy for the AFRL, in partnership with other DoD agencies.

The PNT GRA goal calls for an architecture that easily integrates data from external sensors (e.g., a video camera) and extracts navigational information from the data that will aid in providing the user with a GNSS-quality PNT solution in GNSS-degraded or -denied environments.

Adding to an already full schedule, Miller is now involved in the AFRL’s Space Vehicles Directorate, which is working on a next space-flight experiment called NTS-3. This is a major five-year effort that will culminate with an actual satellite being launched into space hosting a next-generation GPS all-digital payload, a very challenging effort, as not only the space segment is required but also a ground control segment and a very flexible user equipment segment.

## Back to the Beginning

Even as a professional Air Force officer and engineer, Miller manages to remain centered on home and family.



Mikel and Colleen Miller have been married almost 34 years.

Looking back, Miller's older brother Dennis probably had the most influence on him as the first to go to college and AFROTC. "I recall not getting along great with him as a child, but we became best friends in college and still are to this day," Miller says. He is one of the best leaders I've ever met."

After a successful Air Force career, retiring as a colonel, Dennis continues to serve his country as director of engineering and a lead in the Air Force's new Cyber Security Campaign.

Miller stays in close touch with his parents and his sister Patty and brother Steve, both of whom live in New Mexico.

The Millers have raised two sons, Casey and Trevor, and three daughters, Krista, Megan, and Lauren.

Casey, now 32, has been selected for USAF major and is currently a program manager in a system program office in Colorado Springs. He and his wife Lisa have been married for 10 years and have five boys.

Daughter, Krista, 29, is an Air Force pilot, a captain now cross-training in the CV-22 Osprey at Kirkland AFB, New Mexico. She is working on an M.S. in aeronautical sciences at Embry Riddle University and will be getting married next December.

Trevor, 26, received his Air Force commission from the University of Cincinnati and is a recently minted captain and a remotely piloted aircraft Reaper pilot stationed at Creek AFB, Nevada. He and his wife Brittney are expecting their second son next October.

Megan, 21, is a senior at Florida State University studying Hospitality Management, and Lauren, 15, is a junior in high school with a passion for golf.

Over the years, there have been plenty of science projects with his children, including a combined GPS/heart-rate gadget for runners that led to Casey presenting papers at the Institute of Navigation meetings in 2000 and 2001.

Miller and his wife remain active in their church, and one of their dreams is to one day visit the world's holy sites as pilgrims.

With a clear vision and a firm set of priorities, Mikel Miller has found his way to personal success and achievement, making important contributions in the field of GNSS and providing key strategic tools for the security of his country. 

... TO BE EVEN BETTER!

Photo: Sindre Lundvold



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