

## **Per Enge, PhD, NAE**

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## **Stanford University**

**since 1993**

### ***Vance and Arlene Coffman Professor of Engineering***

### ***Director of the Center for Position Navigation and Time***

Enge is the Principal Investigator of Federal Aviation Administration grants to augment the Global Positioning System (GPS). Stanford work included the development and prototyping of the space augmentation system (SBAS). Today, SBAS is carried by over 100,000 aircraft in the United States, and is being deployed worldwide. It aids navigation during enroute flight, terminal area procedures and airport approach. It also widely used for precision agriculture and geographic information systems. Enge also works on high integrity navigation for railway use and to protect transportation from jamming and spoofing. He is a member of the Space Based Position, Navigation and Time Federal Advisory Committee.

## **Worcester Polytechnic Institute**

**1986-1993**

### ***Associate Professor of Electrical and Computer Engineering***

Principal Investigator for US Coast Guard research to design and prototype a medium frequency (MF) radio system to broadcast differential GPS corrections to maritime and land users. Today, this system covers much of the world's coastline and provides differential GPS data to 1.5 million users. Lead designer of the signal and first receiver for this MF broadcast system.

## **Megapulse Inc.**

**1975-1977 and 1979-1984**

### ***Engineering Specialist and Manager.***

Contributed to the design of the first solid state Loran transmitter. Also invented a signaling scheme so that each Loran transmitter can send 10 to 200 bits per second of data without degrading the navigation performance of the signal.

## **Education**

B.S. in Electrical Engineering from the Univ. of Massachusetts at Amherst, 1975  
M.S. in Electrical Engineering from the Univ. of Illinois at Urbana-Champaign, 1979  
PhD. in Electrical Engineering from the Univ. of Illinois at Urbana-Champaign with a dissertation on spread spectrum multiple access communications, 1983

## **Honors**

2013 GNSS Signals Award from GPS World  
2012 Inducted by the Air Force into the GPS Hall of Fame  
2011 Summerfield Book Award for the best book recently published by the AIAA  
2010 Michael Richey Medal for the best paper published this year in the Journal of the Royal Institute of Navigation  
2006 Distinguished Alumnus of Electrical and Computer Engineering at the Univ. of Ill.  
2005 Elected to the National Academy of Engineers  
2004 Fellow of the Institute of Electrical and Electronics Engineers  
2001 Best Academic Paper at the Fifth International Symposium on Satellite Navigation Technology and Applications, Canberra, Australia, July 2001

## Honors (continued)

2001 Fellow of the Institute of Navigation

2000 Kepler Award from the Satellite Division of the Institute of Navigation

1999 President of the Institute of Navigation

1997 Burka Award for the Best Paper in the Journal *Navigation*

1996 Thurlow Award from the Institute of Navigation

1990-2013 Over 30 "Best Presentation of Session" awards at conferences on Global Positioning

## Recent Talks:

1. *Alternate Position Navigation & Time (APNT)*, for the Munich Satellite Summit, March 2014
2. *GNSS Education: MOOCs*, for the Munich Satellite Summit, March 2014
3. *Green Applications of the Global Navigation Satellite Systems*, European Space Agency Summer School on Global Navigation Satellite Systems, Ostrava, August 2014
4. *Evolution of the Global Navigation Satellite Systems for Aviation*, European Space Agency Summer School on Global Navigation Satellite Systems, Ostrava, August 2014
5. *Integrity Concepts and Advances*, Sogei Workshop, GNSS Technology Advances in a Multi-Constellation Framework, Rome, September 2014
6. *Wide Area Augmentation System*, International Aeronautical Congress, Toronto, September 2014
7. *Satellite Based Augmentation Systems: Detect and Remove Faults in Real Time*, International GNSS Conference on Jeju Island, Korea; October 22, 2014
8. *Security For and From Satellite Navigation*, University of Illinois in Urbana Champaign, October 21, 2013, and the University of Texas in Austin, October 18, 2013
9. *Distance Measuring Equipment Accuracy Performance Today and for Future Alternative Position Navigation and Timing (APNT)*, International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS 2013), Nashville, September 2013 (Best Presentation of Session)
10. *APNT & ARAIM (Alternate Position Navigation and Time, and Advance Receiver Autonomous Integrity Monitoring)*, First GNSS Enabled Next-generation Navigation Technology Workshop, Korean Advanced Institute for Science and Technology (KAIST), October 23, 2012
11. *Orbital Diversity for Satellite Navigation from Boeing's Timing and Location System*, International Technical Meeting of the Satellite Division of the Institute of Navigation (ION GNSS 2012), Nashville, September 2012 (Best Presentation of Session)
12. *A Global Safety of Life Service from Multiple GNSS Constellations*, Joint Workshop of the NAE and Chinese Academy of Engineers, Shanghai, (also presented at the National Timing Service Center in Xi'An) May 2011
13. *Satellite Navigation in 2011*, URSI General Assembly, August 19, 2011, and the National Cheng Kung University, Tainan City, Taiwan, November 2011

**Other Information:** Effectively brings academic resource to real world challenges. Academic output includes: two books on satellite navigation; more than four hundred articles on wireless communication and satellite navigation; and effective teaching at Worcester Polytechnic Institute and Stanford University. At the same time, his research effort has resulted in the deployment of two operational navigation systems. The first system began operation in 1995; today, it has over 1.5 million marine and land users. The second system also has over one million land users. It became operational for aircraft in 2003, and is carried by over 100,000 aircraft in 2014. Effective innovation is also evidenced in thirty U.S. patents and many international patents.