Per Enge Biography

Dr. Per Enge is the Vance and Arlene Coffman Professor in the School of Engineering at Stanford University, where he is also the Director of the Stanford Center for Position Navigation and Time. In the past 21 years, he has supported three initiatives of the Federal Aviation Administration that are directed at maximizing the benefit from the Global Positioning System (GPS) to the aviation community.

Since 1995, Professor Enge has served as Principal Investigator for Stanford work on the development and prototyping of the wide area augmentation system (WAAS). This system uses geostationary satellites to broadcast differential corrections and real-time error bounds to GPS users in North America. WAAS came on line for aviation in the United States in July of 2003, and similar systems are being developed in Europe, Japan, India Russia and Korea. Today, approximately 110,000 aircraft carry WAAS avionics.

From 1997 to 2008, Professor Enge served as the Principal Investigator for Stanford work on the ground based augmentation system (GBAS). In time, GBAS will enable automatic landings at critical, high-traffic airports. In the United States, it already supports Category I approach operations at Newark and Houston. So far, air transport has conducted over 1000 approaches based on GBAS.

Since 2009, Professor Enge has served as Principal Investigator for Stanford work on Alternate Position Navigation and Time (APNT) to provide backup navigation capability to critical operations that rely on GPS. This system is based on existing FAA terrestrial navigation aids and will back up GPS in case of a malevolent electromagnetic attack (jamming or spoofing).

Professor Enge is a Member of the National Academy of Engineering and the Federal Advisory Committee for Position, Navigation and Time. In 2012, the U.S. Air Force inducted him into the GPS Hall of Fame. He has received the Kepler, Thurlow and Burka Awards for his work, and he is a Fellow of the ION and the IEEE. He received his PhD in Electrical Engineering from the University of Illinois in 1983, where he designed and analyzed an orthogonal signal set for code division multiple access communications. For recent publications, he has received the Summerfield Book Award from the American Institute of Aeronautics and Astronautics and the Michael Richey Medal from the Royal Institute of Navigation. His written work has been cited over 11,000 times according to GoogleScholar.com.

Relevant Publications (Books):

Parkinson, J. Spilker, P. Axelrad and P. Enge, editors of *Global Positioning System: Theory and Applications,* American Institute of Aeronautics and Astronautics, 1996. This book has been cited over 2700 times according to GoogleScholar.com. Within the book, Enge co-authored the following three chapters:

- B. Parkinson and P. Enge, “Differential GPS,” pp. 3-50;
- P. Enge and A.J. Van Dierendonck, “Wide Area Augmentation System,” pp. 117-142;
- P. Enge and F. Van Graas, “Integration of GPS and Loran-C,” pp. 169-186.

Misra and P. Enge, *Global Positioning System: Signals, Measurements and Performance*, Ganga-Jumuna Press, 2nd printing of the 2nd edition, 2011. This book has been cited over 2000 times according to GoogleScholar.com, and is a standard textbook for satellite navigation worldwide.