3.11 Checking Radar with GPS

Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS (also called NAVSTAR, the official U.S. Department of Defense name for GPS) was originally intended only for military applications. In 1983, Korean Air Lines Flight 007, carrying 269 people, strayed into the USSR's prohibited airspace and was shot down. Following this incident, United States President Ronald Reagan issued a directive making GPS freely available for civilian use, once it was sufficiently developed, as a common good. The first satellite for civilian GPS use was launched in 1989, and the 24th satellite was launched in 1994. GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running while operating on the dark side of the earth. Small rocket boosters on each satellite maintain the correct orbit. Each satellite also contains an atomic time clock.

Today there are more than 30 GPS satellites orbiting the earth twice a day (at a speed of roughly 7,000 miles per hour) in a very precise orbit (about 12,500 miles high) that transmit signal information to earth. GPS receivers take this information and use trilateration to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.

A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more. There are no subscription fees or setup charges to use GPS.

GPS has been enhanced with the addition of WAAS (Wide Area Augmentation System.) WAAS improves the accuracy of GPS by linking approximately 25 ground stations plus two geostationary satellites, or satellites with a fixed position over the equator. The Federal Aviation Administration (FAA) and the Department of Transportation (DOT) developed the WAAS program for use in precision flight approaches. WAAS corrects for GPS signal errors caused by ionospheric disturbances, timing, and satellite orbit errors, and it provides vital integrity information regarding the health of each GPS satellite. In December 2010, the FAA approved GPS with WAAS for navigation aboard commercial airlines.

Two studies have proven that GPS with or without WAAS is capability of accurately measuring velocity and speed. A study conducted in 2004 by the Structure and Motion Lab, University of London, proved that speed detection of GPS (without WAAS capability) was accurate to within 1 mile per hour (1.6 kilometer per hour). A second study conducted in 2005 by the Structure and Motion Lab documented that GPS with WAAS capability can determine speed to within 1 kilometer per hour (less than 1 mile per hour).

It should be noted that GPS rounds to the nearest mile per hour (kilometer per hour) while radar and lidar will always truncate (round down). One mile per hour is within National Highway Traffic Safety Administration (NHTSA) standards for testing the accuracy of radar and lidar. Therefore, an officer may check the accuracy of moving radar by simply maintaining a steady radar patrol speed and comparing that speed with GPS speed. Crosschecking radar, speedometer, GPS and lidar is further evidence that each speed-measuring device is functioning properly. Case law requires the patrol vehicle speedometer must be independently checked for accuracy. **(Note: 10.3 Radar Case Law - United States, Wisconsin v. Hansen and Michigan v. Ferency)**