Narrative Statement

The requested license will enable Geophysical Survey Systems, Inc. (GSSI) to experiment with a novel technology to improve the safety of self-driving cars—specifically, to help the vehicle stay in its correct lane. Present-day approaches use a combination of GPS and optical sensors that read lane markings on the pavement. But GPS is subject to multipath and other interruptions; and optical sensors can fail when snow, dust, or rain obscures the roadway. A car or truck travelling at highway speed may suddenly find itself in the same lane as oncoming traffic.

GSSI is developing a system that builds on the company's 49 years of experience with ground penetrating radar (GPR) technology. A radar array permanently attached under the vehicle looks 2 to 3 meters below the pavement, mapping the subsurface features. (For experimental operation, the antennas may be mounted under a metal plate and towed behind the car.) The unique and stable underground configuration of rocks, soil layers, tree roots, pipes, etc. provides for lane accuracies of about 4 cm.

As a vehicle first drives a particular route, the system creates a basemap of subsurface features, determining locations with precise GPS and/or visible elements such as lane markings and permanent roadside features. The same or another vehicle subsequently stays in its lane by matching its real-time readings to the database map.

Rather than the conventional short-pulse modulation contemplated in the Commission's GPR rules, the system uses stepped continuous-wave frequencies for improved dynamic range and better performance. It complies with the Section 15.509 GPR emissions limits when measured with the step function running.

The device has a row of twelve transmit-receive antennas mounted sideways under the car, from left to right. The antennas operate sequentially in pairs: first 1&2, then 2&3, 3&4, and so on, through 11&12, for eleven pairs. Each pair in turn steps through 51 frequencies, from 103 MHz to 403 MHz, at 6 MHz intervals. Each pair dwells on one frequency for 12.3 μs before moving to the next frequency. At the end of each frequency series is a 32.7 μs time pad. The sequence repeats for each of the eleven antenna combinations, plus a twelfth period of equal duration for calibration, during which the system does not emit RF. A full scan takes 7.92 ms (126 complete scans per second). The fraction of time on any one frequency is 1.7 %. The design emits low-level RF energy less than 30 cm from the ground, with all energy directed into the ground. Both the antenna construction and the mounting location (under the vehicle or under a towed metal plate) provide shielding that minimizes radiation other than that directed at the ground.

The device will operate only when mounted under (or towed behind) a vehicle and pointed at the ground. It will cease operation when the vehicle comes to a halt (as at a red light). In no event will the device operate when the vehicle ignition is turned off.

Of the three sites requested, Nashua NH is GSSI's headquarters, while the other two sites are chosen for their test facilities well as their challenging soil conditions.

Autonomous vehicles promise enormous advantages to society: sharp reductions in accident-caused injuries and deaths; independence for elderly and blind people and those with other physical disabilities; less traffic congestion; more efficient use of roadways; less time taken up in commuting and travel; 24-hour cargo truck operation; and reduced pollution and fuel consumption. A grant of the requested license will help to bring about these benefits.