Radio markers for lane-keeping support system using WLAN

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Abstract

We present the use of radio markers in a lane-keeping support system with WLAN. This system allows safe driving even in blizzards or thick fog. We measured the transmission range and time under snowy conditions and obtained throughput of 10 Mbps with a transmission range of 17 m.

Keywords : Antennas Radio markers WLAN

1. Introduction

In heavy snow, it is difficult for drivers to keep in their own road lane because the snow hides the guardrails and center lines. Blizzards cause transport problems because vehicles have to go slowly or even stop until the weather improves. A lane-keeping support system using cameras has been reported [1]. But the cameras do not work well in poor visibility conditions. Another system has been employed using the global positioning system (GPS) [2] instead of cameras. However, a lane-keeping support system using GPS demands a high-performance GPS system. Such systems are costly and impractical.

In this report, we discuss using radio markers for a lane-keeping support system with a wireless local area network (WLAN). These radio markers can transmit exact position data to a vehicle even in poor visibility, and with this system it is possible to drive safety in blizzards or thick fog. This system is therefore expected to make driving easier and decrease traffic accidents.

2. Lane-keeping support system

Fig. 1 depicts the lane-keeping support system using radio markers. This system consists of radio markers on the roadside and an indication system of the position data received from the radio markers. As a vehicle approaches, the radio markers transmit the position data to the vehicle. The receiver in the vehicle calculates the distances and angles between the vehicle and the radio markers from the received position data and indicates this information to the driver. We used the microwave band (2.4 GHz) because of the low cost and ease of obtaining equipment. With the radio marker, it is necessary that (1) there is sufficient transmission range between the vehicle and the radio marker; (2) the transmission time between requesting and receiving the position data is short; (3) it has long battery life. In this paper, we discuss the measurement of the transmission range and time under snowy conditions.

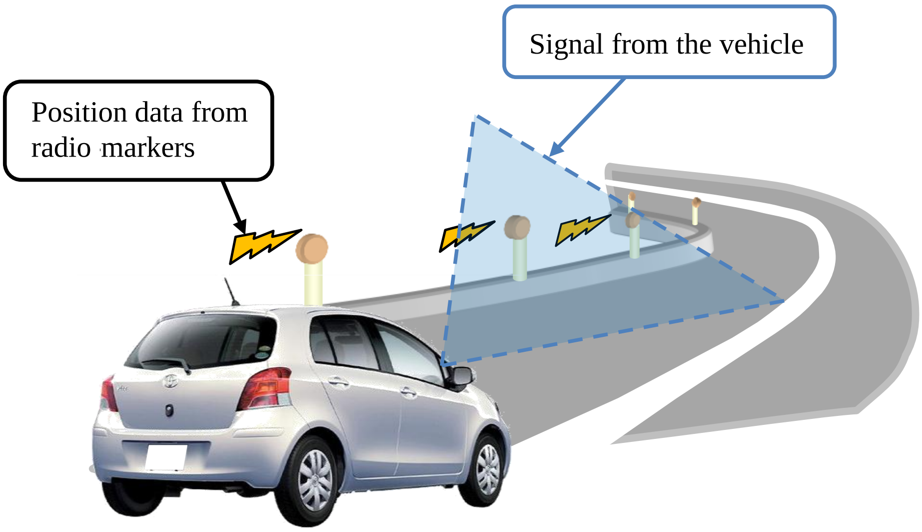

Figure.1: Lane-keeping support system

3. Measurement results

3.1 **Measurement of transmission range**

Fig. 2 shows the measurement setup of the transmission range between the radio marker and the vehicle. We used a 2.4 GHz WLAN with external antennas. The antennas were two patch antennas with 10 dB gain and 30 degree beam width. The output power of the WLAN was set to 10 dBm. We used different ranges between the radio marker antenna and the vehicle, and we measured the throughput. We covered the radio marker antenna with snow, and we used different volumes (thicknesses) of snow.

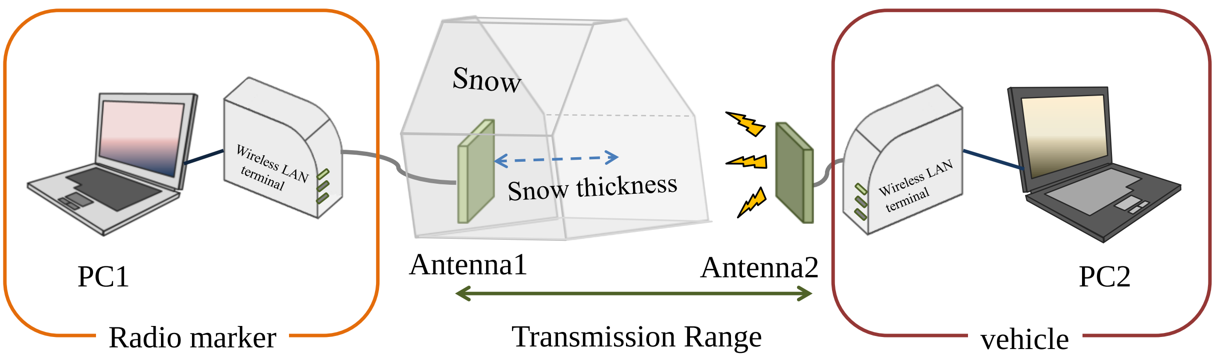

Figure.2: Measurement setup of the transmission range between the radio marker and vehicle

Fig. 3 is a photograph of the measurement. Fig. 4 shows the measured throughput under snowy conditions. The snow caused a throughput decrease of over 5 Mbps, but the influence of the volume of snow was relatively low. This measurement was carried out in March, when the snow was wet and moist. It was thought the water on the surface of the antenna may have increased the transmission loss. If this measurement were performed in January or February, when the snow is dry, not moist, the results would be different.

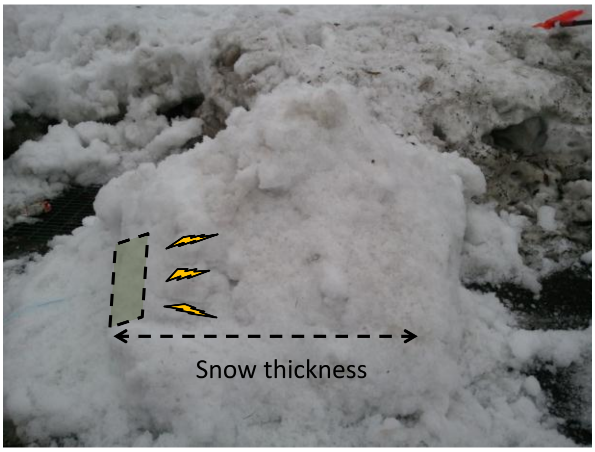

Figure.3: Photograph of the measurement

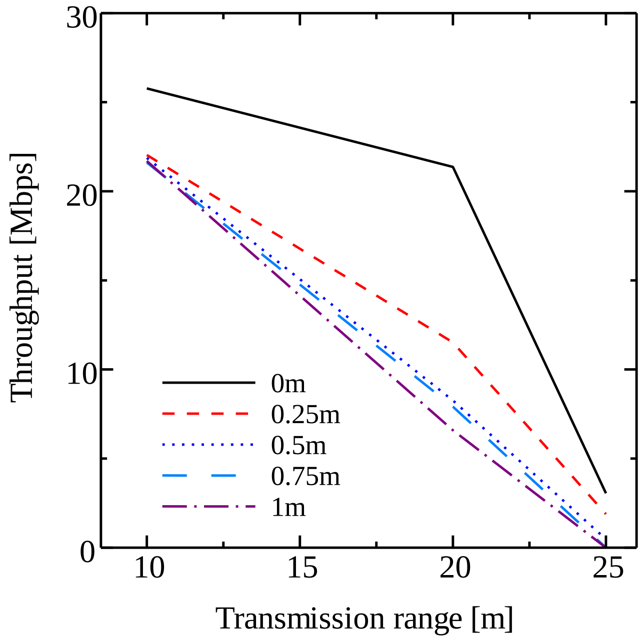

Figure.4: Influence of snow on throughput performance.

3.2 **Measurement of transmission time**

Fig. 5 shows the measurement results for the transmission time and throughput. We developed a program for the measurement, and this program puts the radio marker in a waiting mode. When the radio marker receives a transmission request from the vehicle, it sends the position data back to the vehicle. The transmission time is the execution time of the program. With a throughput of about 10 Mbps, the transmission time becomes less than 10 ms. However, if the throughput is less than 4 Mbps, the transmission time rapidly increases and becomes over 1 s, and the received data cannot be used for this lane-keeping support system.

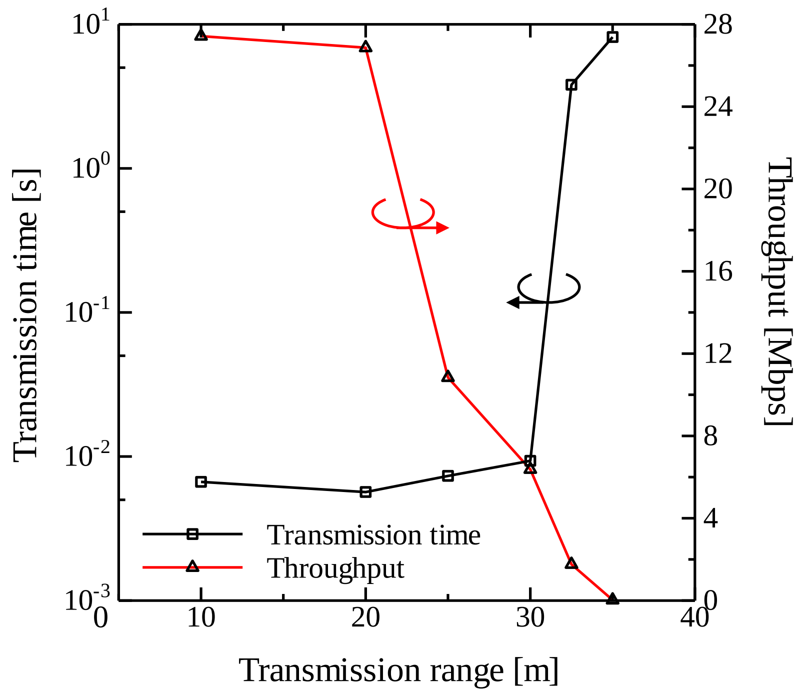

Figure.5: Transmission time and throughput between the vehicle and radio marker

4. Conclusion

In this report, we introduced a lane-keeping support system using radio markers. We discussed the measurement of the transmission range and time under snowy conditions. In the measurement results of the transmission range, the snow decreases the throughput performance. But the influence of the snow volume is relatively small. With regard to transmission time, with a throughput of over 10 Mbps, we can expect under 10 ms, which is a good value for a lane-keeping support system.

References

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