Difference in remote road surface sensor performance by pavement type

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Abstract:
It is important to correctly understand the road surface conditions, so that tactical decisions on the delivery of winter services can be made and appropriate winter maintenance can be implemented. Among the most widely used tools for monitoring winter road surface conditions are road weather information systems (RWIS), which are networks of weather monitoring sensors along roads. Another approach to determining the state of the road surface involves measuring the road surface friction. Recent advances in sensing technologies have put non-invasive surface state sensors into practical use. These non-invasive sensors are able to remotely measure road surface conditions from the side of the road or from winter service vehicles, and to provide cost and operational savings by eliminating the need to install anything in the road or to add any measuring mechanisms to the host vehicle. Although the sensors' ability to provide reliable data has been tested and reported under various conditions, no studies are known to have addressed the reliability of the sensors on different pavement types. This study aims to test the performance of such sensors on different pavement types. The test was conducted at a test track. The test track is 2,700 meters in circumference, and its straightaway, which is paved with dense-graded asphalt (DGA), porous asphalt (PA) and stone mastic asphalt (SMA), was used. As the non-invasive sensor, we used the Vaisala remote surface state sensor (DSC111), which optically measures the thickness of water/snow/ice on the road surface and gives an estimation of grip level. In this study, wet and thin-ice surfaces were artificially created on the test track, and the grip levels and the water/snow/ice thickness values obtained by the DSC111 were compared with the friction values obtained by a continuous friction tester (CFT) and with those measured with a NASA water-film depth gauge, respectively. The test results are summarized as follows. (1) Grip levels are consistent for each surface and correspond to the friction values obtained by the CFT. The precision is good enough to discriminate between the different surfaces. (2) The thickness of the ice layer on SMA obtained by the DSC111 was occasionally greater than the actual value. It is considered that the DSC111 might detect the ice within the voids in the SMA. (3) The pavement type on which calibration of the DSC111 (so-called "dry signals") was conducted have little influence on the measurement results, except for the measurement results for the icy surface when dry signals was conducted on SMA. It is assumed that the water did not totally freeze under the condition of the lowest surface temperature of -1.3 degrees Celsius and that the water on the pavement surface influenced the estimation of the grip revel.