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DETECTION OF RAINDROPS ON A WINDSHIELD FROM AN IN-VEHICLE VIDEO CAMERA

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Abstract. *In this paper, we propose a method to detect raindrops from in-vehicle camera images and recognize rainfall using time-series information. We aim to improve the accuracy of raindrop detection by averaging the test images and frame-matching the result of raindrop detection in multiple adjoining frames. According to an evaluation experiment, raindrops were detected precisely enough for automatic wiper control by the proposed method.*
Keywords: Raidrop detection, In-vehicle camera, Time-series information, Subspace method

1. **Introduction.** Recently, driver assistance with computers and various sensors [2-5], especially in-vehicle camera systems are being actively developed, since images taken from such systems contain important visual information [6]. Human beings visually recognize rapidly changing traffic conditions when driving. In-vehicle cameras may also capture similar visual conditions. The following are examples of driver-assistance systems that use video images to impart traffic-related information; self-steering from white line recognition [7]; distance adjustment between cars from leading vehicle recognition [8]; automatic braking systems from pedestrian recognition [9], and so on.

A close relation exists between driver assistance and weather recognition [10][11]. Since in rain, driving is more difficult than in fair conditions, accident rates dramatically increase. Weather changes temporally and spatially, so we believe that it is important to develop techniques that recognize weather in real-time by in-vehicle sensors for driver assistance. Actually, auto-wiping systems are already implemented on some commercial cars by rain recognition, controlled by a so-called "rain sensor." But employing a specific sensor for each purpose increases the number of sensors which is undesirable from the viewpoint of appearance, space, cost, and maintenance. Since raindrops scatter light, a rain sensor detects rainfall by observing changes in the amount of light received from infrared rays emitted from a LED. However, the target region for detection covered by the sensor is small, so it does not necessarily reflect the changes in the visibility from