Road Profile Level Detector for Profile Leveling and Drafting

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Abstract—**The project road profile level detector for profile leveling and drafting is done for determining the 3D detailed view of the road terrain. We have designed a device that is used for leveling of road or any other terrain. We have attached ultrasonic sensor in the frame attached to the vehicle for resonance free environment. It shows the output in a detailed 3D profile of road or terrain as well as stores all the data in the system. This device is attached to the vehicle to carry out work in an efficient way at both day and night time. This device will be a key for future development in civil engineering field and introduce automation in surveying.**

Keywords—Surveying, Leveling, Profile level detector

I. INTRODUCTION

The project road profile level detector for profile leveling and drafting is done for determining the 3D detailed view of the road terrain. Although there was many equipment for determining the level of the road they are time consuming, requires high labor requirement and skilled labor. Hence for the easy leveling of large terrain we have made a device that provides a pictorial representation of a larger profile in a 3D view. The device may be attached to the vehicle for easy leveling.

The quantitative evaluation of a road surface is important in order to maintain the road effectively. The condition of a pavement influences not only the safety of drivers, but also the comfort level of both drivers and the surrounding environment. Without appropriate maintenance, a damaged pavement can further deteriorate; large cracks and potholes can even cause accidents as well as poor drive comfort and loud noise emissions. Practical road condition assessments widely employed by road owners can be categorized into two groups: those employing visual inspection, and those using precise measurement techniques by employing lasers and other sensors. Visual inspection can be performed without using expensive instruments though the quality of evaluation relies on the skill of the inspectors; the evaluation is subjective. A precise profile measurement typically employs laser and inertia sensors to estimate the profile at regular intervals [1][2]. The laser-based method provides profile estimation with a high accuracy and resolution. However, especially with ordinary road networks, their frequent evaluation through the use of the laser-based method is impractical because of its high cost. A response-based road roughness condition evaluation that is low cost and also provides an objective assessment in terms of some indices has been widely studied. González et al. [3] propose a power spectrum density (PSD) method for the estimation of the roughness of a road surface, based on the transfer function from the road profile to the vertical acceleration of the vehicle body. The performance is validated by several simulations using different road roughness values generated by ISO classes [4]. DRIMS [5][6][7] evaluates the International Roughness Index (IRI) [8], a ride comfort index defined as the accumulated relative displacement of the suspension spring of the Golden-Car, using an accelerometer installed above a vehicle axle. A measurement vehicle is modelled as a Quarter-Car (QC); the ratio of the Golden-Car response power spectrum to the QC response power spectrum is estimated in advance and multiplied by the measured responses.

The responses of the Golden-Car on the measurement target road are thus calculated. IRI is then estimated based on a correlation analysis. To account for both pitching and bouncing motions, DRIMS has been further improved by using a half-car (HC) model taking into account the measurements of both vertical acceleration and angular velocity of the vehicle body using a smartphone [9][10][11]. The IRI estimation was performed in the frequency domain utilizing the ratio of the Golden-Car response power spectrum to the HC model response power spectrum. Other smartphone implementations to estimate IRI have also been reported [12]. These response-based methods evaluate the road condition in terms of specific indices or classification. However, accurate road profile estimation remains challenging. There are some response-based techniques to estimate road profiles. Road roughness reconstructions based on artificial neural networks have been developed [13][14].

A parametric adaptive observer based on the YK parameterization (Q-parameterization) has been used to estimate the road profile [15][16]. Sliding mode observers were also employed for road profile estimation [17]. Combinatorial optimization approaches have been applied to road profile estimation problems [18]. There have been similar applications to railway profile estimation as well [19][20]. A stochastic method was found to have improved its computational efficiency by using Kalman filters [21][22]; the performance of this estimation technique was validated by using sensor-equipped vehicles with known dynamic properties. These methods can estimate road profiles with various levels of accuracy, complexity, and computational cost. However, to date, those methods with experimental validations require the dynamic properties of test vehicles to be known in advance from the vehicle manufacturer, or via laboratory tests and/or suspension motions to be directly