AUTOMATIC COLLECTION AND CLASSIFICATION OF DATA FOR PAVEMENT SURFACE DISTRESSES

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SUMMARY

The collection and analysis of pavement distress data is a primary component of any pavement management system (Paterson, 1987). Currently pavements are usually manually inspected for collection of surface distress data. This form of inspection suffers from several drawbacks:

(i) It is slow, labor intensive and expensive and therefore only a small fraction of the pavement section to be assessed can be inspected. This low sampling rate clearly reduces the accuracy of the process.

(ii) It is subjective and hence consistency between surveys made by different inspectors on the same section may be low. Repeatability may also be poor i.e. the assessment of a section by a given inspector may differ between two inspections even when they are spaced so that little extra deterioration has occurred.

The implications of these drawbacks are, at least in a qualitative sense, obvious: inaccurate condition assessment may result in overmaintaining of pavements, or in expensive deferral of urgently needed repair.

To eliminate the drawbacks of manual inspection, automation of the process is currently receiving increased attention due to its potential to provide highway agencies accurate and detailed data on pavement condition. Among the various technologies, the one based on image collection is the most popular. Various systems exist, or are under development, which record the surface of the pavement on video tape or photographic film and subsequently analyze them either manually at a laboratory, or automatically using image processing and pattern recognition methods. The majority of the systems in the latter category operate off-line. The data are recorded by the moving vehicle and the film or tape is brought to the laboratory for processing, for example overnight.

The focus of this paper is on automatic processing of data of asphalt pavement distresses which can be captured using visual technology. The relevant distress types include cracking (longitudinal, transverse, block and alligator), patching and potholes, which are the most common distress types typically measured by highway agencies for the purpose

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of pavement performance evaluation. We present some systems (existing or under development) for automated collection of pavement distress data and describe their functions, capabilities and limitations.

We also present a methodology developed for automated interpretation of pavement images collected by any of the desired technologies. Automated interpretation of pavement images requires methods for image enhancement, segmentation (i.e. extraction of the object of interest - distress - from the background) and interpretation (i.e. assignment to one of the distress classes of interesr and determination of the extend of the distress)

The proposed methodology is based on a theory for modelling pavement images and consists of the following elements:

- Preprocessing
    - A conceptual image and pixel model of pavement distresses.
    - A simple method for image enhancement
    - A probabilistic segmentation method, which assigns a weight to each pixel based on its probability of belonging to the object or the background; this results in an image where each pixel has one of a possible four values.
- Interpretation
    - A set of primitives that characterize each distress class. More fundamental differences between block and alligator cracking patterns may be captured using these primitives in the feature vector.
    - A classification method that proceeds in two stages: First subregions of the image are assigned to a primitive class and then these primitives are used for global classification of the entire image. The statistical method used for classification at both stages is based on the logit model using appropriate feature vectors for the utility specification. At the first stage the feature vector is based on inertia analysis, while at the second stage the feature vector is based on the primitive classification.

We presented the results of the application of the suggested methodology to a test set of 59 images. The classification system performs well with only one (innocent) misclassification. Its performance is indicative of the potential of the primitive based classification strategy. The results are therefore very encouraging and suggest that the recommended approach has the potential to become the standard method for automated classification of pavement images.