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### 学位論文内容の要旨

The International Roughness Index (IRI) has become one of the major road roughness indexes that most commonly used by the road management authorities and researchers throughout the world since the World Bank has developed it in 1986.

In recent years, road administrators of the Hokkaido prefecture in Japan and Xinjiang region in China are especially requested to create a visual map of a road network to monitor road surface conditions and asked to conduct pavement management on their own roadways more quantitatively. In order to respond these requirements, the purpose of the study mainly focuses to solve the pavement monitoring issues.

Therefore, during the last three years of doctoral research works, measurement, analysis, evaluation and comparison study of the road roughness conditions and ride quality (RQ) affected by the roughness are dealt with, in core cities of Hokkaido and two countries. In this case, efficient mobile road profiler (MRP) developed by Kitami Institute of Technology (KIT), was used together with ArcGIS and mathematical processing software.

Along with the development of response-type road roughness measuring systems (RTRRMS), many countries have developed their own road surface profiling devices in measuring the longitudinal profile or IRI on their roadway sections. KIT developed a new, cost-effective, time-stable, and easily workable compact mobile road profiler (MRP) to address the demand known as "System with Two Accelerometers for Measuring Profile, Enabling Real-time data collection" (STAMPER). The new system is configured with two conventional small accelerometers, a global positioning system (GPS) sensor, an amplifier and a personal computer.

Since 1995 to the present, Xinjiang Expressway in China has been built for total mileage of 4500 kilometer, in recent years local road agencies required to establish a suitable PMS for regional weather conditions in terms of road users saving for the future. In order to respond these demands, authors have carried out road roughness measurement in August 2016, at one of the major trunk expressways in Xinjiang with the total mileage of 874 km, which was initiated at the beginning of the 21<sup>st</sup> century.

On the other hand, in Japan, road networks have been sufficiently developed from

standpoint of road network. From 2013 to present, we have conducted road roughness survey on the municipal road of the different cities, and different road classes, road directions, wheel paths and various conditions of the road roughness in Hokkaido prefecture to carry out a comparison study.

GIS technology is increasingly being considered for implementation for many infrastructure planning and management systems, owing to its superior spatial data handling capabilities. In this study, we used GIS to carry out the spatial evaluation for deteriorated pavement areas based on collected roughness data.

In conclusion, new findings in this paper are summarized as follows:

- STAMPER has proven a significant advantage by enabling road surface profile measurement in real time without a special vehicle.
- It is recognized that visualization using ArcGIS by combining Japan Digital Road Map (DRM) to evaluate and show road conditions of different cities considering seasonal changes is a powerful tool to make decision of establish of the network level of municipal PMS.
- Survey results of the road surface conditions show that RQ analysis according to the ISO 2631 standard represents the different levels of RMS value, which is far from “Uncomfortable” or “Extremely uncomfortable”. It means that ride quality at the measuring locations is acceptable for passengers.
- In accordance with the national highway evaluation standard "JTGF801-2012" of China and testing results of IRI threshold standardized by the Nippon Expressway Company (NEXCO), there is a significant relationship between the IRI and pavement serviceability rating (PSR). The survey results conducted in both countries' expressways proved that level of classification on the roughness is closely common to the both countries.

## 論文審査結果の要旨

近年、我が国では高度経済成長期に構築された社会資本ストックの老朽化が見られ、更新時代を迎えている。このことによる重大事故や維持管理コストの増大が懸念され、これらの課題解決に向けた社会インフラの点検・モニタリング技術の向上が急務とされる。また、路面の平坦性は道路利用者費用や道路の快適性と密接な関係にあり、質的道路整備の観点による路面モニタリング手法の確立が求められている。

本論文では、これらの問題を解決するために、最初にモバイルプロファイラを導入し、様々な測定状況下における国際ラフネス指数（IRI）を測定している。次に測定結果の統計分析を行うとともに複数の地方市街地道路網において、GIS情報による面的IRIデータの可視化を行い、路面状況の実態把握から、高頻度かつ精緻な路面モニタリングの必要性を見出した。

また、路面の局在損傷に着目し、短区間IRI測定による局在損傷の特定と局在損傷が乗り心地に及ぼす影響をISO（国際標準化機構）規格にある衝撃的振動評価指標を用い、定量的に分析している。さらに、我が国と中国の主要幹線道路において、モバイルプロファイラによるIRI測定を行い、路面状況と路面管理基準の比較考察から、地域の実態に即した舗装マネジメントシステム構築の必要性を見出した。

これは要するに、従来困難であった路面プロファイル特性に基づく路面モニタリングの高度化を可能にし、地域特性に応じた舗装マネジメントシステムの開発に係る新知見を得たものであり、アセットマネジメント研究の新たな展開に寄与するところ大なるものがある。よって申請者は北見工業大学博士（工学）の学位を授与される資格があるものと認める。