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学位論文題目	SPEEDING MECHANISM FOR TRAFFIC SAFETY INTERVENTIONS ON RESIDENTIAL STREETS (住宅地道路の交通安全対策のための車両速度構造分析)
論文審査委員	委員長 教 授 久保田 尚 委 員 教 授 川上 英二 委 員 教 授 松本 泰尚 委 員 准教 授 深堀 清隆

論文の内容の要旨

Urban residential streets have the lowest ranking in terms of street function classification. In addition to having the primary function of providing access to adjacent buildings or land lots for all street users, residential streets are also usually used as spaces where local residents can congregate unlike other urban streets. In many cases, pedestrians/cyclists have to share the roadway with motorized vehicles on these roads, which puts them at high risks for accidents. As an attempt to create safer and more livable neighborhoods, a speed limit of 30 km/h has been widely introduced for the majority of urban streets in residential areas. However, despite efforts to slow down motorized traffic by setting the 30 km/h speed limit, excessive speeds on residential streets are very common causing traffic safety problems and threatening the livability of neighborhoods.

To date, abundant of studies have been conducted to explore the determinants of speeding behavior considering street features and human characteristics. However, there has been a very little effort dedicated for speeding on residential streets with a 30 km/h speed limit while it is conceivable that driving on these streets differs in some circumstances from driving on streets with higher speed limits. The present dissertation was designed to fill this gap by exploring speeding mechanism on residential streets with a 30 km/h speed limit for traffic safety interventions by taking into account street features as well as drivers' personalities and psychological factors. Specifically, this dissertation focuses on several aims of research namely (i) to examine residents' perceptions regarding traffic safety on neighborhoods considering traffic conditions and street characteristics; (ii) to develop operating speed models for streets with a 30 km/h speed limit to quantify the influences of street features on driving speeds; and (iii) to explore the impacts of human factors including demographic and psychological variables on speeding behavior on residential streets with a 30 km/h speed limit.

To clarify the rationale of the current research, this study dedicated a part to explore residents' perceptions regarding

the traffic safety of the residential streets (with a 30 km/h speed limit) on which they live by considering traffic conditions and street characteristics. The results show that on average people tend to have a negative perception about the traffic safety of their living street and they do not frequently use the street as an additional space for their daily-life activities. This fact suggests that more efforts should be paid on improving the amenity of neighborhood streets. In addition, traffic volume and vehicle speed were found as the key factors of perceived traffic safety. Although, compared to traffic volume, the role of vehicle speed on traffic safety perception is lower; this study has shown evidences that, reducing the excessive vehicle speeds can be a possible way to satisfy residential needs. Furthermore, various factors of perceived traffic safety and frequency of using residential streets for daily-life activities were discovered in this research that can be used for making these streets as a more enjoyable living environment.

The relationships between street features and driving speeds on residential streets with a 30 km/h speed limit are explored in this dissertation by developing operating speed models for these roads. Rather than using spot-speed data as it was often performed in previous studies, in this study drivers' profile-speeds were measured continuously under an elaborate field survey on 99 street sections with varying characteristics. Several speed models were developed by using advanced modelling techniques such as Simultaneous Equation Approach (SEA) and Neural Networks (NN) to ensure their predictive ability. The results show that various roadway and roadside characteristics associated with driving speeds are incorporated in the developed models. From the road design perspective, the results from these models suggest that attention should be paid to the selection of street section length, the allocation of cross-section elements, and the characteristics of intersections to obtain desired driving speeds on residential streets. While the data in this study indicate that speeding is a serious issue, this work provides a useful tool for coping with this problem. Following the performance based design approach, the relationships between traffic speeds and street environments developed in the current study can be used to assess the speeding issue in existing streets, to re-design streets to make them calmer, and to plan and design new urban streets to meet the intended traffic goals.

This study also explores human factors with respect to speeding and driving on urban residential streets with a 30 km/h speed limit. A survey methodology was developed to individually match attitudinal data (conducted by a questionnaire survey) and drivers' speeding behavior (measured by vehicle speeds observed on the field). The results reveal that almost all drivers often exceed the speed limit and that they still intend to do so in the future if nothing is changed. However, positively the application of a 30 km/h speed limit is supported by a number of drivers and people likely favour protecting the rights of vulnerable street users (i.e., pedestrians/cyclists). In addition, variety aspects of speeding and driving on residential streets with a 30 km/h speed limit were examined including: drivers' knowledge, opinions and attitudes towards speeding on 30 km/h residential streets and the current 30 km/h speed limit; and factors that influence drivers' speed choices while driving on these roads. Furthermore, the determinants of speeding behavior were deeply explored by using the Theory of Planned Behavior (TPB), a well-known theory in psychology, as a frame of reference. Under the framework of the TPB, various factors have been found to be connected with speeding intention and speeding behavior. Importantly, this study demonstrates that, a part from variables that have been found in literature, three new context-based variables namely perceived appropriateness of the 30 km/h speed limit, perceived residential street function, and perceived right of vulnerable street users were found as significant variables of speeding intention/behavior. These variables, therefore, should be taken into account to formulate appropriate policies for tackling speeding issues in residential areas.

On the basic of the abovementioned findings, a comprehensive approach should be used to address the speeding problems on residential areas. First, street environment should be redesigned considering the speed-influencing factors to make it inherently calmer. Secondly, educational measures and/or social campaign programs aiming to altering drivers' speeding behavior should be developed in the light of the speeding mechanism as explored in this study.

論文の審査結果の要旨

学位論文審査委員会は、平成 25 年 8 月 1 日に論文発表会を開催し、論文内容の発表に続いて詳細な質疑と論文内容の審査を行った。以下に審査結果を要約する。

生活道路は、市民の生活の基本的な空間であるにもかかわらず、狭い道路空間の中で人や自転車が自動車と混在せざるを得ない場合が多く、安全上の大きな課題となっている。特に、自動車の速度が速い場合、歩行者等が重大な事故に巻き込まれる恐れが強く、時速 30 km / h 規制をいかに守らせるかが大きな課題となっている。

本研究は、こうした取り組みの基礎となる、自動車の速度モデルについて、道路及び沿道の状況および運転者の心理に着目して構築したものである。生活道路を対象としてこのようなモデル構築がなされた例はこれまでにない。

特に、本研究の特徴と言えるのは次の点である。

- 1) 生活道路の交通安全に関して、交通や道路の特徴に関する沿道住民の意識を分析し、住民の立場からみた生活道路のるべき姿を検討したこと
- 2) 30km/h 規制の道路を対象として、道路や運転者の特性を取り入れた速度モデルを構築したこと
- 3) 速度モデルの構築に際し、個人属性や心理といったヒューマンファクターを取り入れたこと

論文は、第 1 章と第 2 章で、問題設定、文献レビュー、研究目的の設定を行ったうえで、次のような構成となっている。

第 3 章「RESIDENTS' PERCEPTIONS REGARDING TRAFFIC SAFETY ON RESIDENTIAL STREETS」では、沿道住民の意識構造分析を行っている。さいたま市の生活道路沿道住民に対する意識調査データの分析を行った結果、多くの住民が生活道路の危険を実感している実態が浮き彫りになった。

第 4 章「STREET CHARACTERISTICS AND DRIVING SPEEDS」では、生活道路を対象とする自動車速度モデルの構築を行っている。本研究では、「速度」として、従来用いられてきた点速度（道路上の一断面における速度）だけでなく、速度プロフィール（ある車両が道路区間を走行する間の連続的速度）のモデル化を行ったことが大きな特徴である。

データは、さいたま市内の 30km/h 規制の生活道路 99 区間を取り上げ、速度をはじめとする交通状況の他、道路状況を調査した。速度モデルは、Simultaneous Equation Approach (SEA) や Neural Networks (NN) など、複数のタイプのモデルを適用し、比較検討を行った。

モデル構築の過程で、いくつかの道路交通状況、例えば区間長、横断面構成比、交差点等の影響が支配的であることが明らかとなった。

第 5 章「HUMAN FACTORS ON SPEEDING BEHAVIOR」では、速度モデルに、さらにヒューマンファクターを取り入れる試みが行われた。

そのために、各個人ごとに、意識調査から得られる個人属性と、実際に運転した際に実測された速度を関連付ける、という方法を採用した。その結果、まず明らかになったのは、ほとんどの運転者が規制速度 30km/h を上回って走行しているという事実であり、また、ほとんどの運転者が、それに対する罪悪感を持っているという事実でも明らかになった。しかし一方で、ほとんどの運転者は 30km/h 規制そのものには賛同しているとともに、このような道路での歩行者優先にも同意していることが分かった。

その上で、30km/h 規制道路における速度決定要因の分析を行った。要因としては、運転者の知識、30km/h 規制についての意向および態度などの影響が卓越していることが見いだされた。

さらに、速度決定要因を深く探るために、心理学の分野でよく用いられる Theory of Planned Behavior (TPB) を援用した分析を行った。その結果、いくつかの重要な要因が見いだされた。特に、次の3つの要因が見いだされた意義は大きい。すなわち、①その道路での30km/h規制の適切性に関する運転者の認識、②生活道路の機能に関する運転者の認識、③生活道路における弱者(歩行者等)の権利に関する運転者の認識、の3点である。これらの知見は、たんにモデルの精緻化に用いられるだけでなく、生活道路の安全対策といった政策においても有用なものと言えよう。

以上の知見を統合化することにより、生活道路の安全政策に新たな方向性が示されることになる。第一に、生活道路及び沿道のデザインに関して、速度抑制という観点から検討する価値が高いことが示された。第2に、運転者の速度決定メカニズムが明らかになったことにより、運転者への教育やキャンペーンの内容を再精査する手掛かりが得られた。

本研究は、学術面にとどまらず、実務面への貢献も大きい成果が得られたものと判断できる。

これらの研究成果について、これまでに下記の研究業績が発表されている。

Peer-reviewed journal paper

- (1) Dinh, D.D. and Kubota, H. 2013. Profile-Speed Data-Based Models to Estimate Operating Speeds for Urban Residential Streets with a 30 km/h Speed Limit. IATSS Research(Elsevier), Vol. 36, pp. 115-122.
- (2) Dinh, D.D. and Kubota, H. 2013. Drivers' Perceptions Regarding Speeding and Driving on Urban Residential Streets with a 30 km/h Speed Limit. IATSS Research(Elsevier), Vol. 37, pp. 30-38.
- (3) Dinh, D.D. and Kubota, H. Speeding Behavior on Urban Residential Streets with a 30 km/h Speed Limit under the Framework of the Theory of Planned Behavior. Transport Policy, Vol. 29, pp. 199-208.

Reviewed proceedings

- (1) Dinh, D.D. and Kubota, H. 2013. Perception of Traffic Safety and Its Relation to Residents' Frequency of Outdoor Activities. Paper for the Transportation Research Board 92nd Annual Meeting, TRB, Washington, D.C, January, 2013.
- (2) Dinh, D.D., Kojima, A., and Kubota, H. Modeling Operating Speeds on Residential Streets with a 30 km/h Speed Limit: Regression versus Neural Networks Approach. Proceedings of EASTS (2013)/ Journal of the Eastern Asia Society for Transportation Studies. (*conditional accept*).
- (3) Dinh, D.D. and Kubota, H. 2012. Modeling Profile Speeds on Urban Residential Streets with a 30 km/h Speed Limit. Paper for JSCE 14th International Summer Symposium, Japan Society of Civil Engineers, Nagoya, September 2012.

これらの結果から、学位論文審査委員会は、本論文が博士（学術）の学位論文としてふさわしいものであると判断した。