論文 / 著書情報
Article / Book Information

題目(和文)	角度を用いた交通システム分析：モデリングと実証分析
Title(English)	Transportation Systems Analysis with Angle: Modeling and Empirical Studies
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

This dissertation summarizes modeling and empirical studies of angular analysis for transportation analysis. It consists of six chapters.

In Chapter 1, the background and objectives are summarized.
Angle is a periodic value and appears in various aspects of the world. In transportation, the direction in which a traveler moves, the direction of the road, and the time of day are examples of angular indicators. However, angular indicators are difficult to analyze mathematically due to their periodicity. For this reason, angular indicators have not received much attention in transportation. Nevertheless, modeling with angle has the potential to contribute to the transportation systems analysis. In this dissertation, the author builds a framework for transportation systems analysis with angle by applying directional statistics, which is statistics for angular data. Specifically, behavior, temporal, and spatial transportation are modeled from an angular perspective, and the features of the proposed models are empirically analyzed using actual data.

In Chapter 2, related literature is reviewed and summarized. First, directional statistics, which is statistics to analyze angles, is summarized. Specifically, the procedure of angular data, drawing, probability distribution, and regression analysis in directional statistics are explained, and examples of applications other than transportation are summarized. Next, the transportation analysis is classified into demand, supply, behavior, and transportation states. The elementary analytical methods and the recent research on each concept are summarized. In addition, studies that employed angular analysis for each concept are reviewed.

In Chapter 3, a route choice model with an angular indicator was built and validated by empirical studies. In discrete choice models, the turn angle is often described by setting dummy variables as right/left turns or U-turns. However, the results vary depending on the predetermined threshold value. In addition, although both behaviors are essentially changes of travel direction, the two are rarely analyzed as continuous variables without separating them. Therefore, the model describes route choice behavior with the angular indicator, named the turning angle at an intersection. The route choice model is applied to the actual route choice behavior of drivers observed in Tokyo. The results showed that the angular indicator significantly affected drivers' route choice behavior and

In Chapter 4, a model of the daily variation of traffic volume by converting time into angle in order to represent periodicity was built. Since the time in a day is looped in 24 hours, conversion of the time into angles is necessary to describe the time variation. Traffic volume varies with time and has two peaks: morning peak on the way to work and evening peak on the way home. The shape of the two peaks is significantly different, with the morning peak rising quickly and sharply while the evening peak is gentle. In describing these variations in traffic volume over time using a probability distribution, a circular distribution that can represent multimodality and flexible shapes must be employed. Therefore, the mixture of Kato--Jones distribution that satisfies this property was applied to the time variation of traffic volume. Furthermore, a quick and stable estimation method for the mixed Kato--Jones distribution was built. The stability of the estimation method was assessed and interpreted when the time variation was divided into multiple parts.

In Chapter 5, a model that describes the states of OD demand for a certain direction by the directional distribution of overall demand and the road network was built. Describing the entire demand pattern within an area is difficult by conventional approaches. By aggregating the angles

between the origin and destination of each demand, the overall demand pattern can be quantitatively described. In addition, the relationship between transportation states and the morphology of road network, such as whether the road network is grid-like or not, is also difficult to describe using conventional methods. The distribution of the direction of each road in an area can intuitively and quantitatively describe the morphology of the road network. In this chapter, a novel descriptive model that captures the transportation state by overall demand pattern and network morphology is modeled. In addition, the proposed model is validated by transportation data for Tokyo.

In Chapter 6, achievements and future directions are summarized. The achievements of this research are the establishment of a framework for transportation systems analysis with angles by building models for each concept of transportation based on angle. In addition, the proposed models are validated through empirical studies, and the potential of transportation systems analysis with angles is revealed. The future directions include more precise analysis using multidimensional angular variables.