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Boris S. Kerner

The Physics of Traffic

Empirical Freeway Pattern Features,
Engineering Applications,
and Theory



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Preface

This monograph is devoted to a new approach to an old field of scientific investigation, freeway traffic research. Freeway traffic is an extremely complex *spatiotemporal* nonlinear dynamic process. For this reason, it is not surprising that *empirical* traffic pattern features have only recently been sufficiently understood. Such empirical features are in serious conflict with almost all earlier theoretical and model results. Consequently, the author introduced a new traffic flow theory called “three-phase traffic theory,” which can explain these empirical spatiotemporal traffic patterns. The main focus of this book is a consideration of *empirical spatiotemporal* traffic pattern features, their engineering applications, and explanations based on the three-phase traffic theory.

The book consists of four parts. In Part I, empirical studies of traffic flow patterns, earlier traffic flow theories, and mathematical models are briefly reviewed. Three-phase traffic theory is considered as well. This theory is a qualitative theory. Main ideas and results of the three-phase traffic flow theory will be introduced and explained without complex mathematical models. This should be suitable for a very broad audience of practical engineers, physicists, and other readers who may not necessarily be specialists in traffic flow problems, and who may not necessarily have worked in the field of spatiotemporal pattern formation.

In Part II, empirical spatiotemporal traffic pattern features are considered. A microscopic three-phase traffic theory of these patterns and results of an application of the pattern features to engineering applications are presented in Part III and Part IV, respectively.

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Boris Kerner

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