



Introduction to Modern Traffic Flow Theory and Control: The Long Road to Three-Phase Traffic Theory

By Boris S. Kerner

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The understanding of empirical traffic congestion occurring on unsignalized multi-lane highways and freeways is a key for effective traffic management, control, organization, and other applications of transportation engineering. However, the traffic flow theories and models that dominate up to now in transportation research journals and teaching programs of most universities cannot explain either traffic breakdown or most features of the resulting congested patterns. These theories are also the basis of most dynamic traffic assignment models and freeway traffic control methods, which therefore are not consistent with features of real traffic. For this reason, the author introduced an alternative traffic flow theory called three-phase traffic theory, which can predict and explain the empirical spatiotemporal features of traffic breakdown and the resulting traffic congestion. A previous book "The Physics of Traffic" (Springer, Berlin, 2004) presented a discussion of the empirical spatiotemporal features of congested traffic patterns and of three-phase traffic theory as well as their engineering applications. Rather than a comprehensive analysis of empirical and theoretical results in the field, the present book includes no more empirical and theoretical results than are necessary for the understanding of vehicular traffic on unsignalized multi-lane roads. The main objectives of the book are to present an "elementary" traffic flow theory and control methods as well as to show links between three-phase traffic theory and earlier traffic flow theories. The need for such a book follows from many comments of colleagues made after publication of the book "The Physics of Traffic".

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Editorial Review

Review

From the reviews:

“Three-phase theory must be taken seriously, and traditional analysis by traffic engineers should be revised. I hope the book will encourage the traffic research community to employ the concepts and methods that Kerner has so convincingly presented. ... Concepts are clearly illustrated with figures, and the book’s useful glossary of traffic terminology should make the material accessible to graduate students in physics, mathematics, and engineering. ... I highly recommend Introduction to Modern Traffic Flow Theory and Control.” (L. Craig Davis, Physics Today, March 2010)

“The book brings together the various paper publications by Kerner and his coauthors in a concise and readable manner. ... He provides the reader with a set of models that follow three-phase theory and can be used in traffic simulators. I would like to recommend this book by Boris Kerner and like to encourage our community to make use of his models (and theory) in future studies on traffic control.” (Hannes Hartenstein, IEEE Vehicular Technology Magazine, September, 2010)

“This book contains and illustrates a qualitative theory of traffic flow based on three-phase traffic flow models which were introduced by the author and some coauthors in a long series of papers and experiments. ... Interested readers can be recommended to start reading this book” (Hartmut Noltemeier, Zentralblatt MATH, Vol. 1189, 2010)

From the Back Cover

This in-depth treatment explains the nature of traffic breakdown and the resulting congestion in vehicular traffic on the basis of three-phase traffic theory, in a manner consistent with real measured traffic data. The author also addresses freeway traffic control methods within the framework of the theory. He demonstrates and explains why the earlier theoretical basis of transportation engineering, research and teaching cannot adequately describe traffic breakdown as observed in measured traffic data. Links between three-phase traffic theory and earlier traffic flow theories are discussed. Last but not least, the book provides a new fundament for transportation engineering, in particular highway traffic management, as well as the background needed to research the complex system dynamics in traffic flow and transportation networks. It will appeal to students, engineers, and physicists interested in transportation systems and complex dynamical systems in general.

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