



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

*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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