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A symposium in Honor of Carlos F. Daganzo

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Preface

This book contains the papers of the Nineteenth International Symposium on Transportation and Traffic Theory, held in Berkeley, California from July 18 to July 20, 2011.

This symposium series started in 1959 with a gathering of scientists from diverse fields who met to discuss advancements in the then emerging field of traffic science. The success of that first gathering gave birth to the regular series that continues today.

Though automobile traffic theory has remained a focus of this series, its scope has expanded over the years to include theoretical contributions on a variety of transport topics. The symposium's uniqueness perhaps lies less in its subject matter than in its rigorous scientific approach in exploring and advancing these topics.

The papers of this present symposium were subjected to a multi-stage, peer-review process. That process began with the review of well over 500 abstracts that were submitted for consideration; continued with the review of 100-plus of these works in full-paper form; and culminated with the selection of the 36 papers contained in this volume. The large number and high quality of the submission pool made the selection process a very competitive one, and hard choices had to be made. We thank all authors who submitted work for consideration.

We further thank the dozens of referees from around the world for their important work in reviewing abstracts and papers. Special thanks go to the members of the ISTTT19 Organizing Committee, whose names are listed near the front of this book, and who in certain instances reviewed as many as six full papers each. We also thank Helen Bassham for her tireless efforts in organizing the myriad details surrounding this event. Thanks also go to Kitae Jang for his tremendous assistance in managing the logistics of abstract and paper reviews, among other things. The event was generously sponsored by the National Science Foundation, the Federal Highway Administration of the US Department of Transportation, the University of California Transportation Center and the Institute of Transportation Studies at the University of California, Berkeley.

Michael J. Cassidy and Alexander Skabardonis
April 2011

Tribute to Carlos F. Daganzo

We are pleased to dedicate the nineteenth symposium of this series to Carlos F. Daganzo. The venue seems fitting, in part because of Daganzo's many efforts on behalf of these symposia. He has long served as a member of the symposium's International Advisory Committee, and was its Convener from 2002 to 2009. He further served as Organizer of the twelfth symposium in 1993. His assistance in preparing for the present symposium was invaluable.

The venue further seems appropriate in light of Daganzo's immense contributions to transport science. These include his early work in discrete choice theory. Much of the attention in this area was then focused on Logit Models. Daganzo, however, was concerned by the restrictive assumptions that precluded these model forms from capturing correlations across the alternatives of interest. This was known to be a problem in cases involving route choice, for example. Multinomial Probit Models, which were known to account for these correlations, were seldom used at the time due to the computational complexity entailed in their estimation. Rather than let this complexity stand in the way, Daganzo developed numerical methods to facilitate the use of Multinomial Probit. As a result, these forms eventually became the preferred means of modeling route choice. By then, Daganzo's attention had shifted to logistics.

At that time, the logistics field was dominated by models that relied on numerous detailed and case-specific inputs, and on numerical sensitivity analysis, to evaluate narrowly-defined design alternatives. Daganzo, with his knack for abstraction, pursued more general solution methods instead. He chose to describe inputs (such as customer demand) and design choices (such as vehicle routing and facility location strategies) in approximate fashion using a small number of continuous functions, such as spatial density and accumulation rate. Having distilled complex logistics systems in this way, he could then develop relatively simple closed-form expressions that unveil how inputs influence optimal system designs. These generic insights are ideal for high-level decision-making. Thus, for example, when sectors in the automotive industry adopted some of these models in the 1980's, logistic costs sharply fell.

When Daganzo eventually turned his eye to highway traffic, his insights enabled him to make connections between traffic flow and seemingly disparate fields of inquiry. He was the first to discover the fundamental similarities between car-following behavior in congested traffic, and inventory replenishment behavior in supply chains. His pursuit of these connections unveiled root causes of order instabilities in supply chains, and stimulated new lines of research toward eliminating these instabilities and their pernicious economic impacts.

His focus on highway traffic led to other seminal works as well. A stubborn adherence to the physics of real traffic is the hallmark of each. His theories on traffic, like those from his other research thrusts, continue to influence others. Multiple examples of this influence are contained in the pages of this book. The examples include: a study by Japanese researchers that uses Daganzo's variational theory of highway traffic (see paper #13); exploratory work by a trans-Atlantic research team to extend Daganzo's recent macro-level work on city-street networks (paper #11); and work by US scholars that shares some of the ideas of Daganzo's Cell Transmission Model (paper # 30).

To date, the record of Daganzo's research includes three textbooks and a monograph that are widely regarded as classics, and an immense body of publications in archival journals and other outlets. These constitute a treasure trove for transport scientists. Now well past his sixtieth birthday, Daganzo continues to produce at a pace that seems even somehow to have quickened. The focus has shifted yet again, this time to include greater emphasis on public mass transit and on other solutions for combating congestion on city-wide scales. The trademark creativity and clarity of thought continue, and these are on display in his co-authored papers #6 and #20 of this book.

One recent effort deserves special mention: his creation of an elegant new course on Public Transportation Systems, with detailed course notes available on the ITS Berkeley website. These notes offer a unified view of transit planning and operation, and entail modeling approaches that are general enough for application to taxi and paratransit systems, as well as to traditional fixed-route, fixed-schedule modes. The notes stand as testament to Daganzo's diverse analytical skills, and to how these have been honed over the years.

The energy he devoted to create these course notes is in keeping with his commitment to teaching and mentorship. His insistence on excellence, coupled with his generosity of spirit, has made Daganzo an exemplary advisor of doctoral students. This was recognized in 2008 when he received the prestigious Distinguished Faculty Mentoring Award from the UC Berkeley Graduate Assembly. Yet, the best proof will always be his former students, many of whom are on the faculties of top universities across the US and around the world. They are making contributions of their own, and samples of their recent contributions are featured in this book.

In closing, we acknowledge that the few words of tribute offered here only scratch the surface of Daganzo's legacy. A fuller accounting of his transformative contributions is a task that we leave to others. The list of candidates for this task includes: those who have studied under Daganzo; those who have studied under his students; and those who have studied his works to become inspired by them.

The list is long. It will grow longer with time.

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ISTTT19 Organizing Committee

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Traffic theory. International series in. Operations research & management science.Â Traffic theory, after modelling of traffic movement, moved into modelling of interactions of traffic movements aimed at improving them through appropriate control of traffic movement through devices such as traffic signals or other means of regulating the rate of flow of traffic past a control point. This theory studies the dynamic properties of traffic on road sections. We begin this course with a theoretical framework in which the characteristics of traffic flow are described at the microscopic level.Â The theories and models that will be discussed are developed on the basis of numerous observations on motorways. There is a difference between motorways and lower order roads such as provincial roads and urban streets. For the latter it are the intersections that dominate flow characteristics to a large degree.