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Ghosh, Sumit and Tony Lee. "Intelligent Transportation Systems; New Principles and Architectures." *Boca Raton, FL: CRC Press LLC, 2000. ISBN 0-8493-0067-3; 177 pp. + CD-ROM.*

Klein, Lawrence A. "Sensor Technologies and Data Requirements for ITS." *Boston and London: Artech House, 2001. ISBN 1-58053-077-X; 549 pp. + CD-ROM.*

'Tools of the (ITS) Trade'

by Michael S. Bronzini

One of the impediments to the development of intelligent transportation systems (ITS) has been the lack of good textbooks providing the "tools of the trade" for transportation professionals to use in planning and designing such systems. These two offerings might be viewed as attempts to fill this void. The first volume, by far the slimmer of the two, has a title promising a broad scope but it is, in fact, quite narrow, while the second sounds very specialized but covers much territory.

The **Ghosh and Lee** text is driven by the notion that transportation systems are best characterized as large-scale, decentralized, asynchronous systems that require novel distributed control algorithms for safe and effective operation. The central theme of the book's eight chapters is to present a suite of several such algorithms and report the results of various simulation-based tests of their performance. Chapter One lays the groundwork by providing a short overview of the fundamental nature of transportation systems, focusing on the problems of control, coordination, and resource management. In layman's terms, modern transport systems have the revolutionary property that each vehicle and each control point can and do have computing and communication capabilities, permitting real-time adjustments in system operations that are responsive to current network conditions.

Chapters Two and Three then turn to the problem of scheduling train operations via autonomous processing distributed between the trains and the stations. Chapter Two first lays out the basics of train dispatching via centralized traffic control, and points out the limitations imposed by slower and slower response times as system complexity and traffic increase. The rest of the chapter presents the authors' DARYN algorithm, which implements a distributed approach where each train requests a "hard" reservation for the next track segment on its route, and each station considers competing reservation requests and allocates train track segment reservations.

Chapter Three presents a more advanced algorithm, RYNSORD, that allows "soft" reservations for several track segments in a route. Both algorithms are tested via implementation on a set of loosely coupled parallel processors, and the performance metrics indicate that this approach produces efficient schedules and is scalable in the face of increasing traffic loads. Copious details on

Journal of the Transportation Research Forum. Published in *Transportation Quarterly,* Vol. 56, No. 4, Fall 2002 (195–197) © 2002 Eno Transportation Foundation, Inc., Washington, DC.

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the computing aspects, and the RYNSORD program itself, on its CD-ROM, are provided. While no actual implementations of these algorithms by US railroads are reported, the authors state in the Preface that the ideas presented underlie the operating system employed by the East Japan Railway Company.

In Chapter Four, Ghosh and Lee attempt to extend their railroad algorithms to intelligent vehicle highway systems (IVHS), and it is here that the book breaks down. The problem stems from the authors' lack of familiarity with modern highway operations and real IVHS, as they overstate the role of traffic management centers (TMCs), fail to consider the mounting body of research on varying levels of market penetration of in-vehicle ITS devices, and ignore entirely third-party traffic information service providers. Further, the crude traffic flow model that they develop essentially ignores the results of 50 years of progress in the field of traffic flow theory. They proceed to test their distributed processing algorithm on a small network, but have no basis for comparing its performance against that of a TMC-based system, lacking a simulator for the latter. They overlook the obvious possibility of comparing their results against either static equilibrium network assignment solutions, or solutions generated by current generation traffic simulators such as NETSIM or DYNASMART. Further, the details of their synthetic tests are too sparse to be able to judge the statements that are made about the quality of the solutions generated.

Chapters Five and Six deal with various technical and computing aspects of the algorithms, and Chapter Seven is a two-page speculation on future issues, echoing Chapter One. In summary, the book is largely of interest to computer scientists working on intelligent transport systems that look very much like railroads, and doesn't have much to offer to analysts dealing with highways and other modes.

Klein's book delivers exactly what it promises, and much more. Much like the Transportation Research Board's *Highway Capacity Manual*, the book's scope is broad, ranging from the basics of traffic flow theory and statistical analysis down to myriad how-to-do-it technical details. The focus is squarely on the data required for real-time traffic adaptive control, and the technical characteristics and capabilities of the sensors available to provide these data. Requirements for monitoring and controlling arterial streets, expressways, and highway networks are all included.

Chapter One sets things up by reviewing current highway performance and persuasively showing the need for accurate measurement and proactive control, and Chapter Two covers the basics of traffic flow variables and relationships. This material will be familiar to experienced traffic analysts. The real meat of the book is in Chapters Three and Five. Chapter Three is an exhaustive treatment (116 pages) of the traffic management applications of sensor data, and covers such topics as isolated and interconnected intersection signal control, traffic-adaptive signal control systems, freeway incident detection, priority vehicle preemption, and detection and analysis of sensor failures. For each application typical subtopics presented include objectives, data needs, processing algorithms, and accuracy requirements. Chapter Five discusses the technical aspects of the operation of virtually all types of traffic sensors, including video image processors, radar, infrared, acoustic, and magnetic sensors, inductive loop detectors (of course!), and even obtaining traffic flow data from cellular telephones.

The only weak chapter in the book is the fourth, which struggles to say something meaningful about the potential data requirements of future traffic management applications. Chapter Eight is also a bit obtuse, as it presents various approaches to developing data fusion algorithms but fails to provide

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either a comprehensive theoretical treatment or a practical guide to implementation; nonetheless, it is a useful introduction to the topic and will encourage those interested to pursue more detailed references.

The remaining chapters provide useful technical details related to the design and installation of traffic sensing and dedicated short-range communication systems. Additional technical details are in 12 appendices presented as pdf files on an accompanying CD-ROM. The only quibble here is that most of the many tables included are presented in a top-to-the-left format, which means that most users will have to print them for easier reading. In summary, Klein has produced a book that will be useful as a text for specialized traffic and systems engineering courses, and that is highly recommended as a shelf reference for practitioners.

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