The Ten Most Important Research and Development Needs for Computer Traffic Control. Workshop March 20-22, 1974.

URBAN TRANSPORTATION (CURA)

Abstract

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Needs for Computer Traffic Control
by
Daniel L. Gerlough and K.S.P. Kumar

A Workshop on Computer Traffic Control, bringing together users, designers, suppliers, consultants, university faculty members, and students was held March 20-22, 1974. The Workshop developed research and development needs for computer traffic control. The paper lists, in rank order, the ten most important of these needs.

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by
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Introduction

The application of computers to the control of traffic on city streets has been underway for about 15 years and to the control of traffic on freeways for about 10 years. Those metropolitan centers that have installed successful computer traffic control systems have found that all segments of traffic, including buses, private cars, and even pedestrians benefit from improved traffic flow. The improved flow decreases fuel consumption and air pollution. Numerous metropolitan centers are considering or planning computer traffic control installations. In spite of the importance of computer traffic control there had been no organized gathering of users, suppliers, designers, and researchers to survey the state of the art and define future research and development (R and D) needs.[3]

Workshop

Recognizing the value of such a meeting, a Workshop on Computer Traffic Control was held March 20-22, 1974 under joint sponsorship of the University Research Program of the U. S. Department of Transportation and the University of Minnesota. Forty persons representing users, designers,

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1 Paper prepared for presentation at the annual meeting of the Institute of Traffic Engineers, Detroit, Mich. September 15-20, 1974.

2 Fellow, I.T.E.

3 There have, of course, been papers at various technical meetings, and the Federal Highway Administration has from time to time held conferences of its contractors. There had not, however, been a meeting of representatives of users, suppliers, designers, and researchers to attack the one question of computer traffic control.

suppliers, consultants, the Federal Government, universities, and students gathered for two and a half days at the Springhill Conference Center, Wayzata, Minnesota.

Background to discussions was provided by three state-of-the-art papers covering

1. Street traffic computer control systems
2. Algorithms for computer traffic control
3. Computer control of freeway traffic.

The participants were organized into small discussion groups, with each group assigned a specific subject area. Each group developed R and D needs related to its specific area. These needs were presented in oral reports and subjected to discussion at a plenary session.

Following the workshop, written summaries of R and D needs were prepared and submitted to all participants for assignment of weights. To accomplish this weighting each participant was given 100 points which he/she might allocate in any manner to the various R and D items. The points from the various participants were tabulated and summarized. From these results the following may be cited as the ten most important R and D needs for computer traffic control, listed in rank order.

Ten Most Important R and D Needs

1. Perform a sensitivity analysis to ascertain the impact, upon traffic operational performance, of improvements in each component of an on-line system i.e. where should we invest our resources to gain the greatest improvements in system performance?

For example, to what extent will increasing detector density from 1.8 to 2.6 detectors per intersection improve traffic operations? What net effect will accrue in the addition of another 4K of core or

of a disc drive to the computer configuration. Is a display panel cost-effective for a community with 10 intersections?

2. Investigate the feasibility of establishing general and consistent formats for specifications, for defining systems and equipments, software, etc. including:

Documentation needs

Operating support requirements

Maintenance - Hardware/Software/and Operational

A standard specification should not be prepared for hardware and software elements of a system. However, a standard format which could be used to produce specifications of a functional nature that encompasses all elements of a system is appropriate and necessary.

3. Make a full quantitative analysis of the cost/benefit tradeoffs between centralized and distributed control.

a) Consider various levels of decentralization (tiering).

b) Consider the influence of the network size.

c) Consider the flexibility of the two control approaches with respect to changes in network structure, new hardware technology, changes in software (for example, implementation of new control strategies).

d) Consider the adaptability of decentralized systems when failures occur in part of the network.

e) Consider the issue of maintainability/reliability of the system under normal usage.

4. Conduct a survey to quantify each of the realizable incremental benefits that can accrue from the installation of on-line computer

control. The data generated in this task would support the sensitivity analysis of Task 1.

5. Consider guidelines and recommendations for providing safeguards to users in procuring bids.

Present procurement practices, i.e. competitive price bidding, guarantee neither the lowest price nor equipment meeting specifications. Better prequalification requirements should help, and changes in legislation might be necessary to permit either method for procurement.

6. Investigate a mechanism for reporting and collecting user experience on systems - e.g. monthly reporting on a standard from - failure experience, what features actually are being used, hours of operation in various modes, etc.

While this does not strictly call for an R and D effort, its implementation is of great importance to users and potential users. The subject of computer failures and the resultant requirement for back-up systems is greatly misunderstood by potential users. This problem is due to a lack of good information of the experiences of present users of computers in the traffic control.

Similarly there is now no medium for exchanging information on new techniques or practices which may have widespread application possibilities.

7. Assume a distributed control system for computer traffic control. Identify the levels of control needed; develop coordination principles among the various controllers; develop distributed control algorithms that are less sensitive to errors in detector output information. Develop new control strategies under the general assumption that microprocessors will find an increasing role in traffic control.

8. Develop and validate theories to describe microscopic behavior and interactions of vehicles on the stability of a freeway, and identify factors which cause breakdown. Include random effects. Quantify the hysteresis effect which impedes recovery of flow to stable operations.

9. Define the elements which interact in Urban Traffic Management, and develop an understanding of their interactions. This would include organization studies of the various jurisdictions and authorities that are involved, and their interaction to improve total traffic movement.

10. Develop method for (sensitivity) testing of control policies, and of objective function specification. Specify corridor and network environments in terms of time-varying origin and destination patterns and volumes. We cannot now predict the consequences of a priori candidate policies.

Proceedings

A Proceedings of the Workshop has been prepared and will soon be available for distribution. This document will contain the state of the art papers, a complete list of all R and D items, and a roster of participants.