The fuel use and air quality consequences of each alternative are also listed in Table 1. Increased emphasis on air quality impact of transportation alternatives can be evaluated via an optional subprogram resident in the NETSIM model.

RECOMMENDED PROJECT

Based on analysis of parking use, traffic engineering analysis of field data, NETSIM simulation data analysis, and professional judgment, it was recommended that the turn pockets on Dover Avenue and turn pocket on East Travis Boulevard eastbound movement with stop sign control on Dover Avenue be implemented.

CONCLUSION

In my opinion, the NETSIM computer simulation model further expands the traffic engineer's ability to analyze and evaluate alternatives in a cost-effective manner.

Typical Application of the TEXAS Model

Glenn E. Grayson

This paper describes a simple application of the TEXAS computer model by a traffic engineer in a small city. (TEXAS is a microscopic model for simulation of traffic at a single intersection. It is currently available from the Texas State Department of Highways and Public Transportation.) TEXAS allows traffic engineers to evaluate changes in intersection parameters (traffic flow, intersection geometry, and intersection control) and to see what effect those changes have on the vehicles' and intersection's performance. TEXAS is comprised of three separate computer programs: GEOPRO, DVPRO, and SIMPRO (see Figure 1).

GEOPRO takes geometric information about the intersection system (approach lengths, number of lanes per approach, lane geometry and type, and location of any sight distance restrictions) in a cartesian coordinate manner; it produces a list of possible paths down which vehicles will travel. This path information is used as input to SIMPRO. DVPRO also produces input for SIMPRO. This driver-vehicle processor takes volume and headway distribution information and creates a time-ordered list of vehicles. Three types of drivers and 16 classes of vehicles are used. SIMPRO takes these two inputs and a third, which contains the description of intersection control (from unsigned to signed to signalized) and the duration of simulation. Vehicles are "stepped through" the system, and speed and delay statistics are gathered for each time increment for each vehicle.

At the end of the simulation run, the statistics are summarized for the total intersection, for each approach, and for each turn movement in each approach. During a typical time increment, each car examines the vehicle in front, the adjacent lane(s), and the traffic control at the intersection. Then it makes a deterministic decision whether to speed up, slow down, start, stop, or change lanes. Because of the deterministic nature of the model, the traffic engineer is able to ascertain the effects of a change in one of the three parameters (traffic flow, intersection geometry, and intersection control) with only two runs: "before" and "after". The following is a description of how I used the model in just this way and was able to make comparisons between two runs.

Richardson is a Dallas suburb with a population of 80 000. Its 53 traffic signals are located at arterial intersections on a suburban grid and are, for the most part, noninterconnected and fully actuated. When these signals were installed, multiphase, fully actuated operation was the state of the practice. At many of the locations left-turn phasing was provided, even though during the peak period only three to five vehicles made the left turns each cycle. It had been observed that those three left-turning vehicles were causing unnecessary delays to the opposing through movement. With the increased emphasis today on reducing overall delay and fuel consumption, about 10 locations were targeted for protected left-turn removal in one or both directions. On January 10, 1981, left-turn green arrows

Figure 1. TEXAS model: flow process.

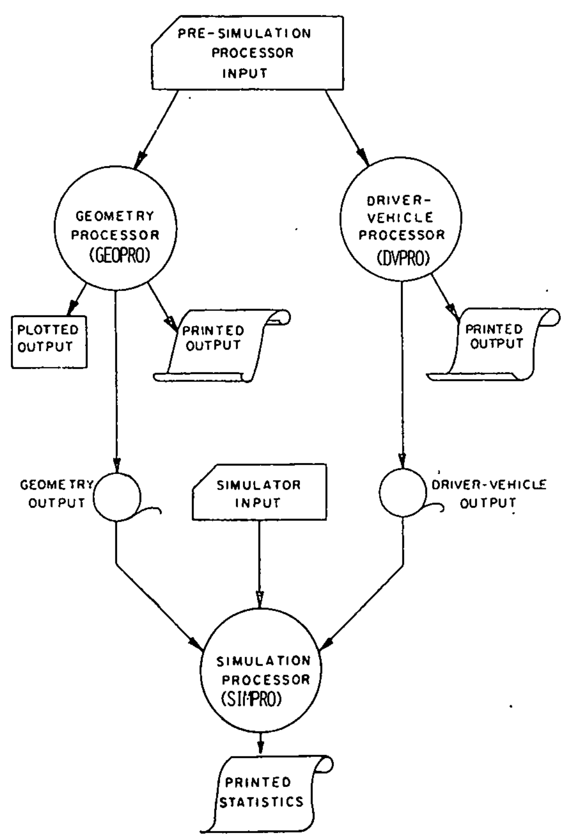


Figure 2. Sketch of Arapaho-West Shore model location.

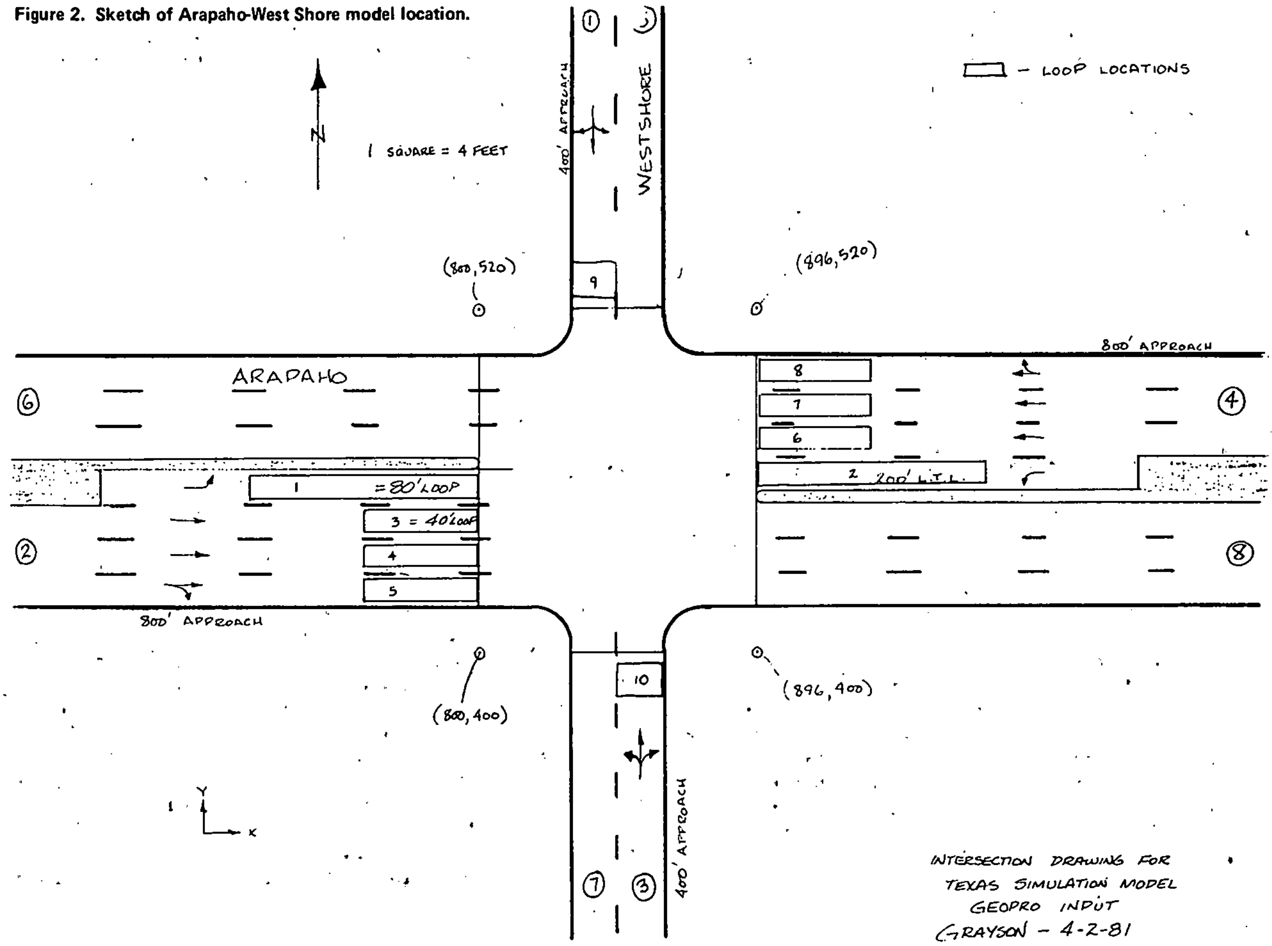
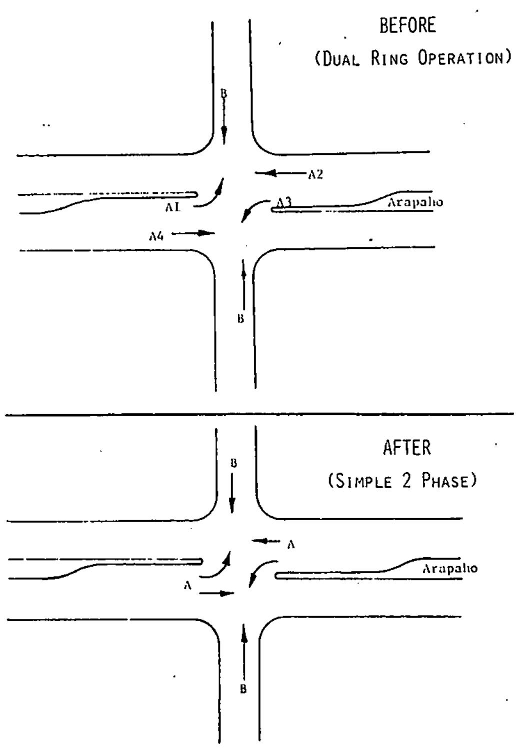


Figure 3. Before and after signalization phasing.



were bagged at three intersections for a three-month test. Citizen complaints begin to come in to the traffic engineering office and to the city manager's office. At this point, it was decided that it would be worthwhile to get some quantitative data to corroborate the engineering judgment used. The computer simulation approach was chosen for analysis, and the necessary input data were gathered to run the TEXAS model. (The Texas State Department of Highways and Public Transportation provides computer time to localities for these types of model runs.)

The location chosen to be modeled (Arapaho with West Shore) was similar to the other two. Arapaho is a six-lane divided major arterial and West Shore is a 36-ft undivided collector street. Figure 2 shows a simplified sketch of the intersection from which all necessary geometry information was taken. Volume counts were taken in the left-turn lanes and the through lanes on Arapaho, and for each approach on West Shore. Five-phase signalization (existing prior to January 10, 1981) was simulated for the first SIMPRO run. Two phase signalization (after January 10) was simulated for the second SIMPRO run. Figure 3 shows the before and after signalization phasing.

Reported statistics from each run include total delay, stopped time delay, queue delay, travel time, average speed, queue lengths by lane, and traffic signal performance. These are reported for the intersection as a whole, for each approach, and for each turning movement on each approach.

By analyzing these statistics from the before and after runs, it was possible to state the following findings (all are for a peak hour) in changing from five phase to two phase.

1. 3300 s less stopped time will be incurred overall at the intersection (an 11 percent reduction).
2. Six percent fewer vehicles will stop (50 percent, down from 56 percent).
3. One hundred fewer through vehicles will have to stop on the main street (40 percent, down from 50 percent).
4. A 5-s reduction in average stopped time will be obtained by through vehicles on the main street.
5. A 10- to 15-s increase in average stopped time will be accrued by left-turning vehicles on the main street.
6. The main street's signal split will increase from 53 percent to 68 percent.

With these data in hand, an interoffice memo was written to the city manager's office justifying the phasing change. The memo also included items on accident experience, field observation, warrants, and citizen response. Final approval has not yet been received, and there is a chance that the recommendations may be overruled. Richardson is still a small city, and citizen input is a very important factor in decisions made by the city council and manager's office. The quantitative data provided by the TEXAS model have added considerable support to the initial field observations and recommendations made to the city manager.

This small problem required only 1 h to code and run, then another 1-2 h to evaluate the results. Considering the total amount of time spent on this project, these 3 h probably were the most productive. Likewise, it is felt that the TEXAS model can easily provide the practicing traffic engineer with delay and speed data that are nearly impossible to measure in the field, but are very useful in evaluating proposed transportation system management changes. It is hoped that, in the near future, the model will be available through more agencies (such as FHWA) so that more local traffic engineers will be able to use this tool.

Comparison of NETSIM Results with Field Observations and Webster Predictions for Isolated Intersections

Christian F. Davis and Timothy A. Ryan

The results described here are offered as examples of user experience with the NETSIM computer program. They deal with research (1) that grew out of previous work conducted for the Connecticut Department of Transportation on prediction of air pollution generated by vehicular traffic. While it was felt that the vehicle emissions and fuel consumption options of NETSIM would give results that could be used directly, it was also felt that the simulation model could be used as a research tool to investigate the range of applicability and sensitivity of various analytic approaches. Consequently, the re-

Figure 1. Intersection of Route 195 and South Eagleville Road.