ABSTRACT
Travel demand can be elegantly represented using an Origin-Destination (OD) matrix. The link counts observed on the network are produced by the underlying travel demand. One could use these counts to reconstruct the OD matrix. An offline approach to estimate a static OD matrix over this research. Almost all the offline methods use linear models to approximate the relationship between the on-ramp and off-ramp counts. Previous work indicates that the use of a traffic flow model embedded in a search routine performs better than these linear models. In this research, SUN, and a gradient based optimization routine, MINOS, interfaced to estimate an OD matrix. This approach is an application of the Prediction Error Minimization (PEM) method. The problem is non-linear and non-smooth, and the optimization routine finds multiple local minima, but can not guarantee a global minima. However, with a number of starting "seed" matrices, an OD matrix with a good fit in terms of reproducing traffic counts can be estimated. The dominance of the mainline counts in the OD estimation and an identifiability issue are indicated from the experiments. The quality of the estimates improves as the specification error, introduced due to the discrepancy between the traffic flow model and the real world process that generates the on-ramp and off-ramp counts, reduces.

METHODOLOGY

OPTIMIZATION - MINOS
- State of the art – Optimization software
- Stanford OR Department – Bruce Murtagh, Michael Saunders
- FORTRAN77 source code – 14 files
- Solve a variety of non-linear programming problems
- OD Estimation problem
  - Linearly constrained minimization – Reduced gradient algorithm
  - Define – dimensions of problem, specify the constraints and initial values
- Objective Function – return F(x) for a given x.
  - Use current OD and create trip table
  - Call AIMSUN
  - Get the counts
  - Calculate F(x)

SEED GENERATION PROCESS
- Starting solutions for search
- 5 methods
  - Equal Splitting percentages
  - Proportional percentages
  - Destinations are likely based on the offramp counts irrespective of origin
  - Iterative Method
  - Iterative method of balancing trip table using proportional method
  - Gravity Model
  - Based on gamma function for impedance function
  - Turning percentage based
  - Using turning percentages, irrespective of origin

SIMULATOR - AIMSUN
- Advanced Interactive Microscopic Simulator for Urban and Non-urban networks
- Input
  - Network
  - Travel Demand – OD matrix, Input volumes and turning %
  - Traffic Control – Lights, stop yield signs, ramp meters
- Model in AIMSUN
  - Freeways – sections and centroids
  - Dedicated origins/destinations
  - No control
  - OD Matrix – time sliced trip tables generated by external program
  - Constant Headway
  - No route choice models
- Features
  - All files stored in ASCII format
  - One folder holds all network information
  - Helpful for the interface

RESULTS FROM SECOND SITE – REAL DATA

RESULTS FROM FIRST SITE

OPTIMIZATION FUNCTION FOR 1-DAY’S DATA

RESULTS FROM SECOND SITE – REAL DATA

OBJECTIVE FUNCTION FOR 5-DAY’S DATA

FIRST SITE – IMAGINARY ROAD SECTION
- Test the experimental setup
  - Check the interface and method
  - Simple freeway section
  - 2 origin, 2 destination
  - 2 constraints
  - 2 independent variables

SECOND SITE – TH-169

- 8.5 mile section between Th-55 and 63rd Avenue
- 11 on-ramps, 12 off-ramps

CONCLUSIONS
- Offline method to estimate OD Matrices
- Simplicity – traffic flow model embedded in optimization
- Enhancement of what Dr. Davis proposed with seed generation
- Freeways (2 test sites)
  - Simulated data sets
    - Good reproduction of system properties and counts
    - Plot of objective function – insightful
    - Radar data set experiment – interesting results
  - Real data
    - Not as good as simulated data sets
    - Multiple solutions (different)
  - Possible Issues
    - Identifiability
      - Map as generated by AIMSUN
    - Discrepancy between AIMSUN and reality

FREEWAY ORIGIN DESTINATION MATRICES, NOT AS SIMPLE AS THEY SEEM
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