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Data Files: Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity

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GENERAL INFORMATION-------------------

1. Title
The Metadata for Bi-objective Optimization for Battery Electric Bus
Deployment Considering Cost and Environmental Equity

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CONTEXTUAL INFORMATION------------------

1. Abstract for the dataset
The dataset contains 9 seperate categories of data, all of which are used
to generate, analyze or visualize the results of the project. The dataset

is collected through multiple sources and organized into different formats including CSV format, JSON format, shapefile and code repository.

2. Context of the research project that this dataset was collected for. The research project develops a bi-objective model that aims to help transit agencies to optimally deploy BEB while considering both capital investment and environmental equity. The unique spatio-temporal characteristic of BEB system, charging limitations (on-route and in-depot charging), and operational constraints are also considered and incorporated into the model.

3. Date of data collection:
The data was collected during 2019-08-01 to 2020-04-30.

4. Last modification date
Date dataset was last modified on 2021-01-10.

5. Funding sources that supported the collection of the data:
This project was funded by the National Institute for Transportation and Communities (NITC; grant number 1222) a U.S. DOT University Transportation Center.

SHARING/ACCESS INFORMATION------------------------1.

Publications related to the dataset:
A. Y. Zhou, X. C. Liu, R. Wei and A. Golub, "Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity," in IEEE Transactions on Intelligent Transportation Systems, doi: 10.1109/TITS.2020.3043687.
B. Ran Wei, Xiaoyue Liu, Yi Ou, S. Kiavash Fayyaz, "Optimizing the spatio-temporal deployment of battery electric bus system," in Journal of Transport Geography, doi:10.1016/j.jtrangeo.2018.03.013.

DATA & FILE OVERVIEW--------------------

File List   1. Filename: BusRoutes_UTA   Containing subfiles: YES
     Source: Utah Transit Authority (UTA)
     Summary: The folder contains the shapefile of bus routes of UTA in year 2016. Shapefile format consists of files with common filename prefix, stored in the same directory.
     Software used for processing the data: ArcMap
     Subfiles: A. BusRoutes_UTA.cpg
          Description: Specifing the code page (only for .dbf) for identifying the character encoding to be used.

     B. BusRoutes_UTA.dbf
          Description: Attribute format; columnar attributes for each shape, in dBase IV format.

C. BusRoutes_UTA.prj
        Description: Projection description, using a well-known text
representation of coordinate reference systems.

    D. BusRoutes_UTA.sbn
        Description: A spatial index of the features.

    E. BusRoutes_UTA.sbx
        Description: A spatial index of the features.
        F. BusRoutes_UTA.shp
        Description: Shape format; the feature geometry itself.

    G. BusRoutes_UTA.shp.xml
        Description: Geospatial metadata in XML format, such as ISO
19115 or other XML schema

    H. BusRoutes_UTA.shx
        Description: Shape index format; a positional index of the
feature geometry to allow seeking forwards and backwards quickly.

  2. Filename: BusStops_UTA   Containing subfiles: YES
     Source: Utah Transit Authority (UTA)
     Summary: The folder contains the shapefile of bus stops of UTA in
year 2016. Shapefile format consists of files with common filename
prefix, stored in the same directory.
     Software used for processing the data: ArcMap
     Subfiles:
     A. BusStops_UTA.cpg
        Description: Specifing the code page (only for .dbf) for
identifying the character encoding to be used.

    B. BusStops_UTA.dbf
        Description: Attribute format; columnar attributes for each
shape, in dBase IV format.

    C. BusStops_UTA.prj
        Description: Projection description, using a well-known text
representation of coordinate reference systems.

    D. BusStops_UTA.sbn
        Description: A spatial index of the features.

    E. BusStops_UTA.sbx
        Description: A spatial index of the features.

    F. BusStops_UTA.shp
        Description: Shape format; the feature geometry itself.

    G. BusStops_UTA.shp.xml
        Description: Geospatial metadata in XML format, such as ISO
19115 or other XML schema

H. BusStops_UTA.shx
            Description: Shape index format; a positional index of the
feature geometry to allow seeking forwards and backwards quickly.

    3. Filename: UTA Runcut File Aug2016.xlsx
       Containing subfiles: NO
       Source: Utah Transit Authority (UTA)
       Summary: The file contains network information of UTA buses in year
2016.
       Software or Language used for processing the data: Python

    4. Filename: TAZ
       Containing subfiles: YES
       Source: WFRC
       Summary: The folder contains the shapefile of Traffic Analysis Zone
in the Salt Lake Metropolitan area.
       Software or Language used for processing the data: ArcMap
       Subfiles:
       A. TAZ.cpg
            Description: Specifing the code page (only for .dbf) for
identifying the character encoding to be used.

       B. TAZ.dbf
            Description: Attribute format; columnar attributes for each
shape, in dBase IV format.

       C. TAZ.prj
            Description: Projection description, using a well-known text
representation of coordinate reference systems.

       D. TAZ.sbn
            Description: A spatial index of the features.

       E. TAZ.sbx
            Description: A spatial index of the features.

       F. TAZ.shp
            Description: Shape format; the feature geometry itself.

       G. TAZ.xml
            Description: Geospatial metadata in XML format, such as ISO
19115 or other XML schema

       H. TAZ.shx
            Description: Shape index format; a positional index of the
feature geometry to allow seeking forwards and backwards quickly.

    5. Filename: Marginal_Income.xlsx
       Containing subfiles: NO
       Source: WFRC
       Summary: The file contains the size of four income group at TAZ
level.
       Software or Language used for processing the data: Python 2.x

6. Filename: SE_File_v83_SE19_Net19.xlsx
   Containing subfiles: NO
   Source: WFRC
   Summary: The file contains the household size, household
population, and employment level at TAZ level.
   Software or Language used for processing the data: Python 2.x

7. Filename: Pollutant Concentration.xlsx
   Containing subfiles: NO
   Source: https://www2.purpleair.com/
   Summary: The file contains readings of pollutant concentration
extracted from PurpleAir Sensors from Oct 1st to Oct 14th, 2019.
   Software or Language used for processing the data: Python 2.x

8. Filename: Code for Optimization
   Containing subfiles: YES
   Source: Yirong Zhou
   Summary: The folder is the repository of code used for implementing
the optimization framework.
   Software or Language used for processing the data: Python 2.x
   Subfiles:
   A. ele_bus.py
       Description: This file contains the major class defined in
order to store necessary information.
   B. ele_glpk_solve.py
       Description: This file sotres the function to call GLPK
solver.
   C. ele_gui.py
       Description: This file creates a Graphical User Interface for
interaction, dynamic input, and multi-threads.
   D. fileHandler.py
       Description: This file reads in and parses all sources of
data.

9. Filename: Code for Visualization
   Containing subfiles: YES
   Source: Yirong Zhou
   Summary: The file contains readings of pollutant concentration
extracted from PurpleAir Sensors from Oct 1st to Oct 14th, 2019.
   Software or Language used for processing the data: Python 2.x
   Subfiles:
   A. vis.html
       Description: The main HTML file.
   B. chart.js
       Description: The javascript file that defines dropdown box
and proccesses data.
   C. firstView.js
       Description: The javascript file that generates the first
view of the visualization.
   D. secondView.js
       Description: The javascript file that generates the second
view of the visualization.
   E. thirdView.js

Description: The javascript file that generates the third view of the visualization.
          F. styles.css
              Description: The CSS file that styles all the elements.
          G. screencast.mp4
              Description: A screen cast that demonstrates how to use the visulaization.
          H. data
              Description; A folder contains the necessary data of deployment plans, bus stops, bus routes, and information of TAZ.

TABULAR DATA-SPECIFIC INFORMATION FOR: 1-B. BusRoutes_UTA.dbf-----------
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1. Number of variables:
5

2. Number of cases/rows:
114

3. Variable List
     A. Name: LineAbbr
        Description: Abbreviations for bus lines.
      Nominal

     B. Name: LineName
        Description: Names of bus lines.
      Nominal

     C. Name: Service
        Description: Category of service of bus lines.
      Nominal, including local, express, BRT, fast bus, shuttle, ski, flex.

     D. Name: Frequency
        Description: Frequency of bus lines.
      Ratio

     E. Name: Shape_Leng
        Description: Length of the bus routes.
      Ratio, unit: foot

TABULAR DATA-SPECIFIC INFORMATION FOR: 2-B. BusStops_UTA.dbf-----------
----

1. Number of variables:

2. Number of cases/rows:
5987

3. Variable List
   A. Name: StopId
     Description: Unique identifier for bus stops.
    Nominal

   B. Name: StopName
     Description: The comlete names of bus stops.
    Nominal

   C. Name: StreetNum
     Description: The number of the streets the stops are on.
    Nominal

   D. Name: OnStreet
     Description: The name of the streets the stops are on.
    Nominal

TABULAR DATA-SPECIFIC INFORMATION FOR: 3. UTA Runcut File Aug2016.xlsx------
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1. Number of variables:
9

2. Number of cases/rows:
6878

3. Variable List
   A. Name: LineAbbr
     Description: Abbreviations for bus lines.
    Nominal

   B. Name: ServiceName
     Description: Weekday or Weekend service.
    Nominal, including WEEKDAY, SATURDAY, and SUNDAY.

   C. Name: DirectionName
     Description: The name of the destination stop.
    Nominal

   D. Name: block_num
     Description: The unique identifier for different buses.
    Nominal

   E. Name: trip_id
     Description: The unique identifier for different trips.

Nominal

     F. Name: from_stop
        Description: The name of the origin stop.
      Nominal

     G. Name: FromTime
        Description: The time when buses begin the trip.
      Interval

     H. Name: to_stop
        Description: The name of the destination stop.
      Nominal

     I. Name: ToTime
        Description: The time when buses end the trip.
      Interval

TABULAR DATA-SPECIFIC INFORMATION FOR: 4-B. TAZ.dbf--------------------
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1. Number of variables:
2

2. Number of cases/rows:
2881

3. Variable List
     A. Name: CO_TAZID
        Description: Unique identifier for TAZs.
      Nominal

     B. Name: AREA
        Description: The area of the TAZ.
      Ratio, Unit: squre foot

TABULAR DATA-SPECIFIC INFORMATION FOR: 5. Marginal_Income.xlsx------------
----

1. Number of variables:
6

2. Number of cases/rows:
2881

3. Variable List

A. Name: CO_TAZID
       Description: Unique identifier for TAZs.
     Nominal

    B. Name: INC1
       Description: The number of households in income group 1 ($0 -
$34,999).
       Ratio

    C. Name: INC2
       Description: The number of households in income group 2 ($35,000 -
$49,000).
       Ratio

    D. Name: INC3
       Description: The number of households in income group 3 ($50,000 -
$99,999).
       Ratio

    E. Name: INC4
       Description: The number of households in income group 4 (over
$100,000).
       Ratio

    F. Name: TOTHH
       Description: The number of total households.
       Ratio

TABULAR DATA-SPECIFIC INFORMATION FOR: 6. SE_File_v83_SE19_Net19.xlsx------
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1. Number of variables:
5

2. Number of cases/rows:
2881

3. Variable List
    A. Name: CO_TAZID
       Description: Unique identifier for TAZs.
     Nominal

    B. Name: TOTHH
       Description: The number of total households.
       Ratio

    C. Name: HHPOP
       Description: The total household population.
       Ratio

     D. Name: HHSIZE
       Description: The average household size.
     Ratio

     E. Name: TOTEMP
       Description: The number of total employment.
     Ratio

TABULAR DATA-SPECIFIC INFORMATION FOR: 7. Pollutant Concentration.xlsx-------
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1. Number of variables:
3

2. Number of cases/rows:
438

3. Variable List
    A. Name: lat
       Description: Lattitude of the PurpleAir Sensor.
     Interval

    B. Name: lon
       Description: Longitude of the PurpleAir Sensor.
     Interval

    C. Name: PM2.5_ATM_ug/m3
       Description: The concentration of PM 2.5.
     ratio, unit: ug/m3