Analysis of Cyclist Behavior Using Naturalistic Data: Data Processing for Model Development

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Introduction

➢ **Background**
- Bicycle becomes a healthy and sustainable mode of travel in many cities.
- There is still lack of knowledge on cyclist behavior and models.
- Modeling tools are important for bicycle network planning and operations.

➢ **Objective**
- Present an essential methodological framework for processing and modeling cyclist behavior using naturalistic data;
- Model acceleration behavior of cyclists using processed naturalistic data;
- Integrate the model in a simulator under development.

Naturalistic Data Collection

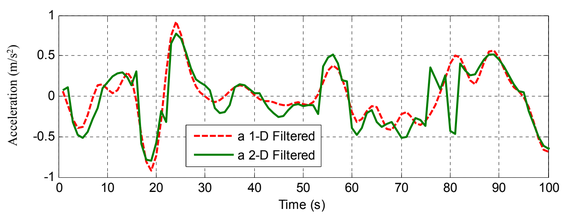
Figure: Data collection device and representative cycling trajectories

➢ **Participants**: Eleven commuter cyclists and 126 available cycling trips.
➢ **Device**: Garmin Edge 500 GPS and other devices.
➢ **Area**: Stockholm.
➢ **Measurements**: *GPS data* (latitude, longitude, distance and speed) and *altitude data* with a time interval of one second.

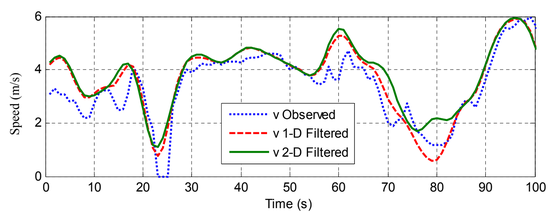
Data Preprocessing

➢ **Data quality issues**:
- Blank tuples in GPS data;
- Measurement noise in both GPS data and altitude data.

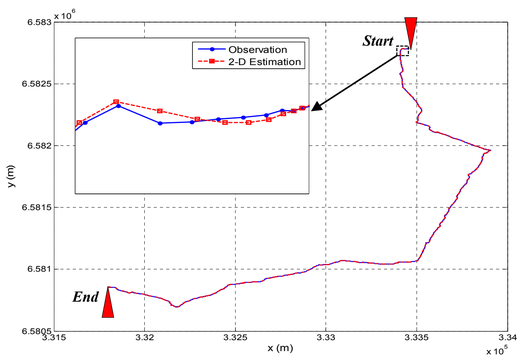
➢ **Solutions**:
- GPS data: 2-D Kalman filter (latitude & longitude);
- Altitude data: Locally weighted regression.



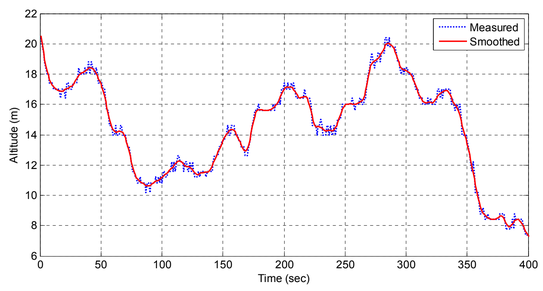
(a) Acceleration profile



(b) Speed profile



(c) Trajectory profile



(d) Altitude profile

Figure: Examples of comparison results between the observed data and smoothed data

Data Analysis

➢ **Profile selection**
- Criteria are set to identify acceleration, cruising and deceleration behaviors.

➢ **Descriptive analysis**
- Both acceleration and deceleration cases demonstrated S-shape curves for speed-time profiles and U-shape curves for acceleration-time profiles.
- Critical variables (initial speed, final speed, speed increment, average acceleration rate, maximum acceleration rate, etc.) can be extracted from the profile.

➢ **Statistical analysis**
- The critical variables are used to apply correlation and regression analysis.
- Variation of speed has strong linear correlations to both maximum and average acceleration rates.

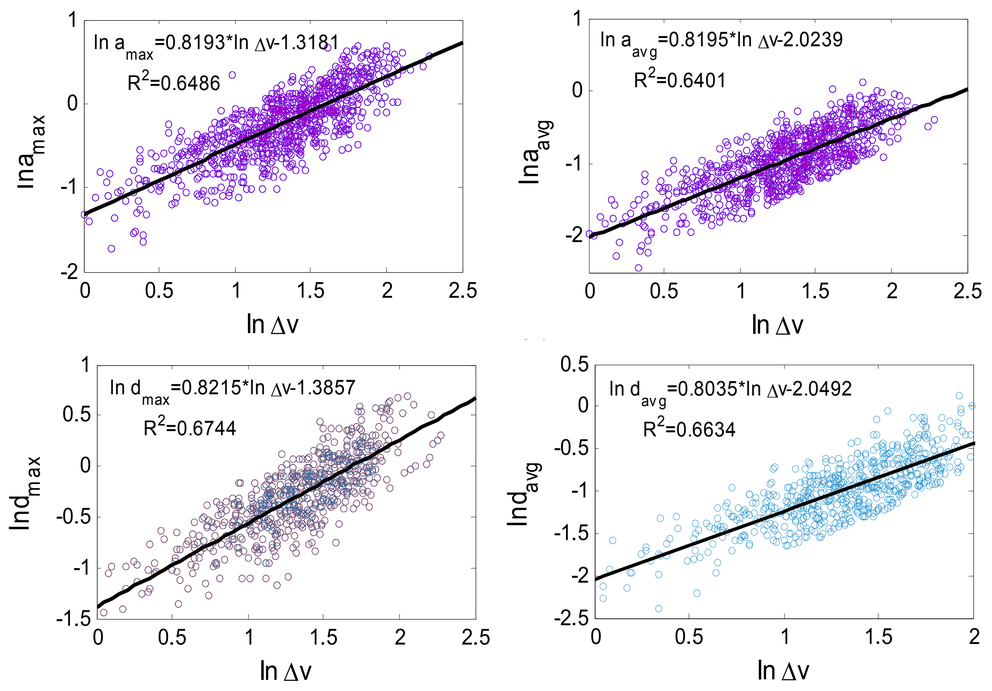


Figure: Regression models with the transformed data

Acceleration Model

➢ Main ideas of model formulation:
- To capture the U-shape of acceleration process;
- To reflect the influences of initial speed on cyclist behavior;
- Identify the model parameters using processed naturalistic data and maximum likelihood methodology.

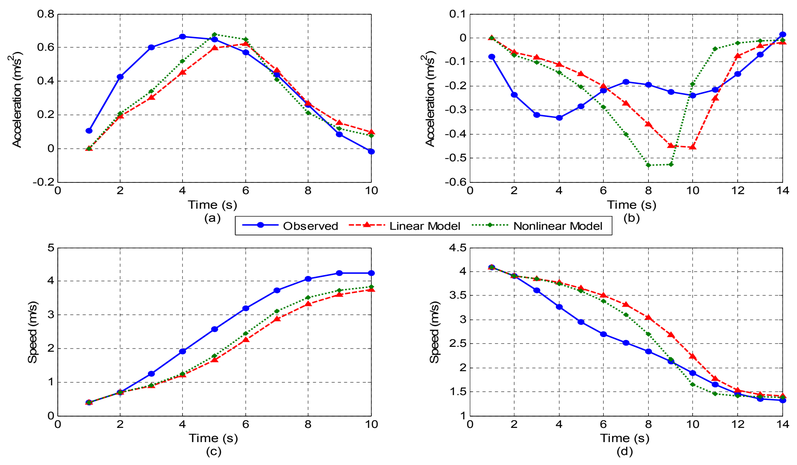


Figure: Comparison between the observed profiles and estimated profiles

Summary and Conclusions

➢ Acceleration-time profiles show U-shape curves and some characteristics of the acceleration behavior are revealed.
➢ This paper demonstrates the potential of the naturalistic cycling data for identification of behavioral models

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