

Innovative Re-Uses of GPS Data collected during yearly Road Condition Surveys

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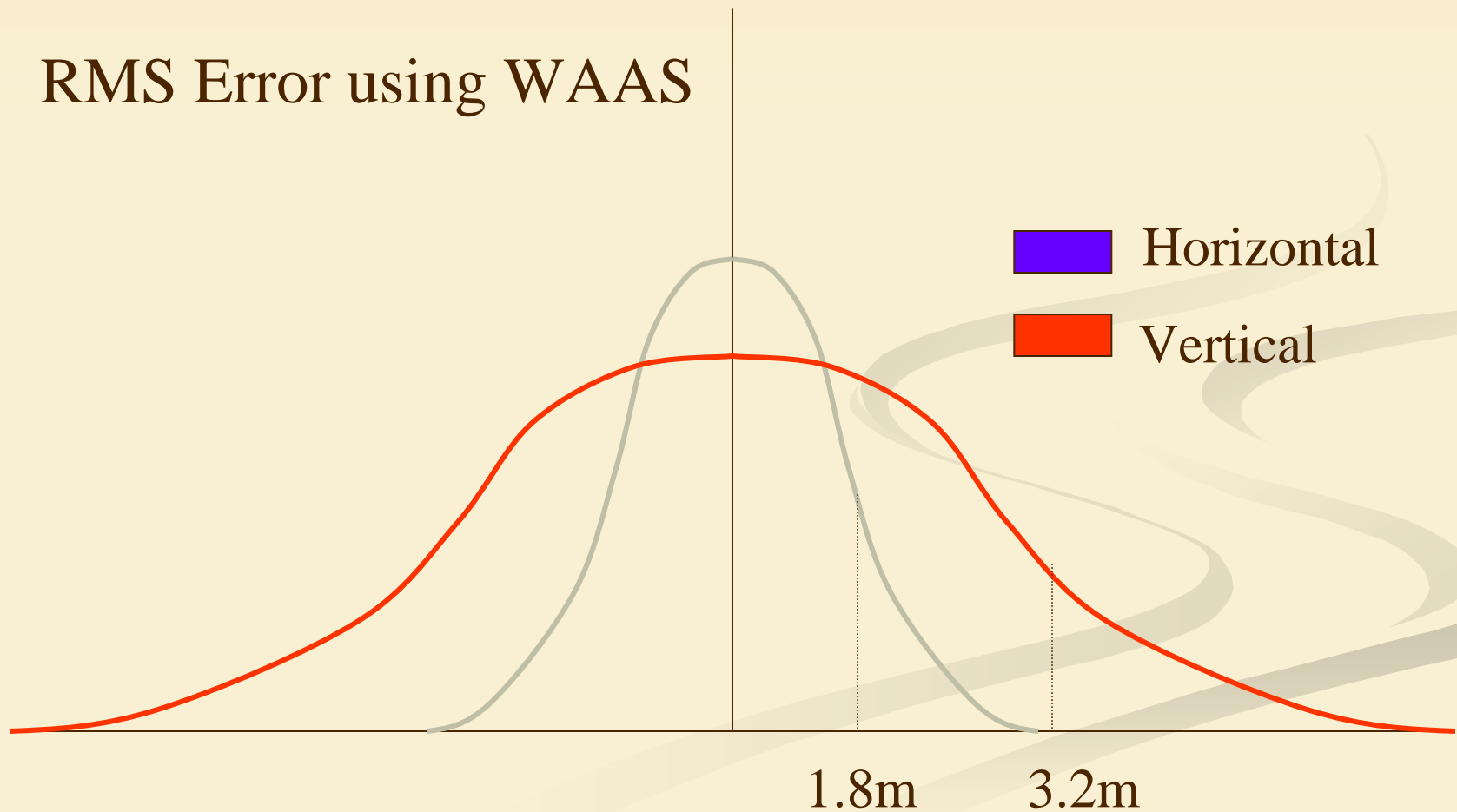
May 7, 2007

GPS Data Archive

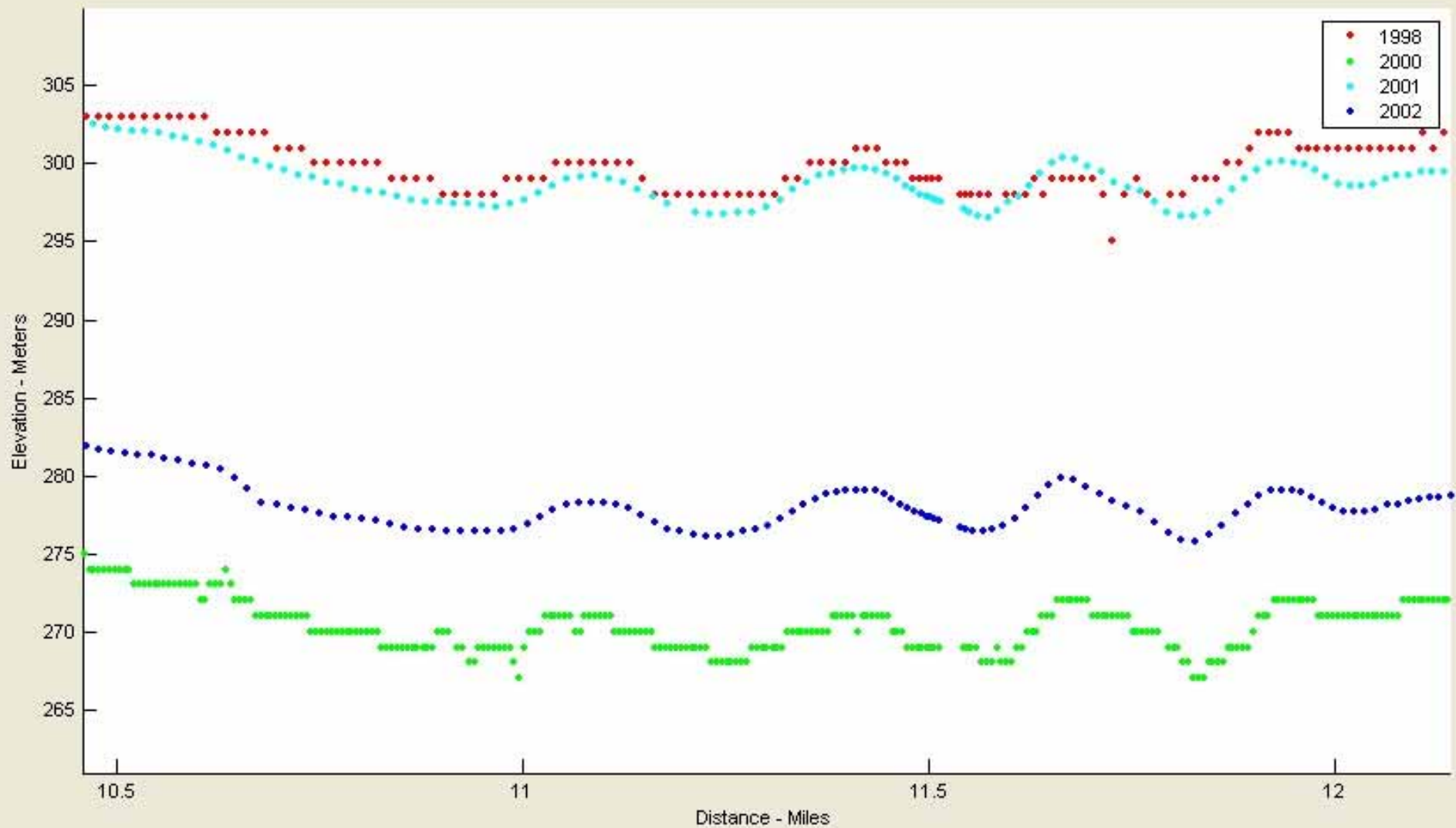
- 15 million data points as of 2007
- Spans >10K miles of state highway
- Collected since 1997
- By-product of two different road surveys
- Pre & post SA, Differential and nondifferential, filtered and nonfiltered
- Truncation effects, jamming, signal obstructions

Common GPS Error Characteristics

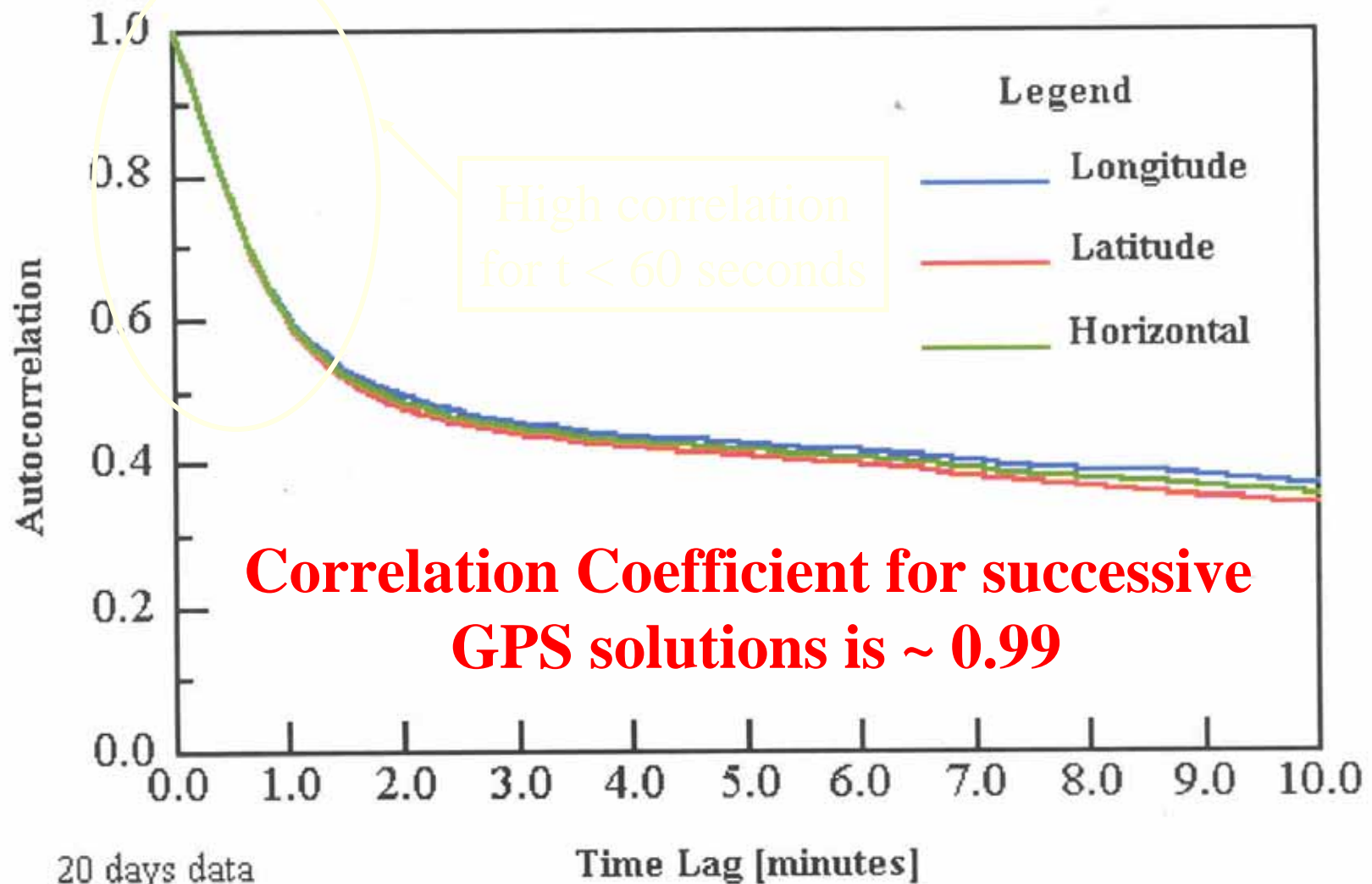
RMS Error using WAAS



Actual Vertical Errors

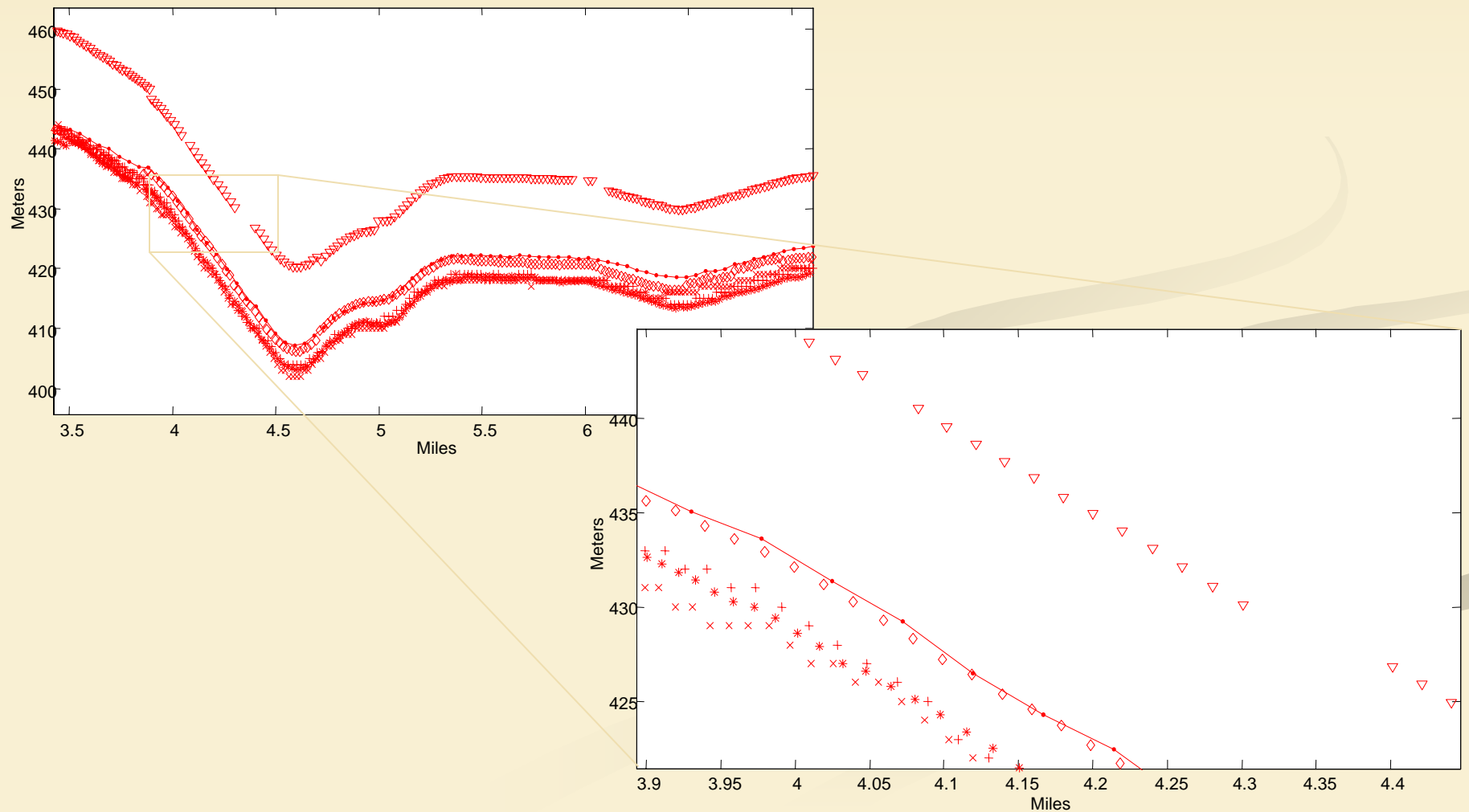


AUTOCORRELATION OF ERRORS GARMIN 12XL (Micropulse antenna)

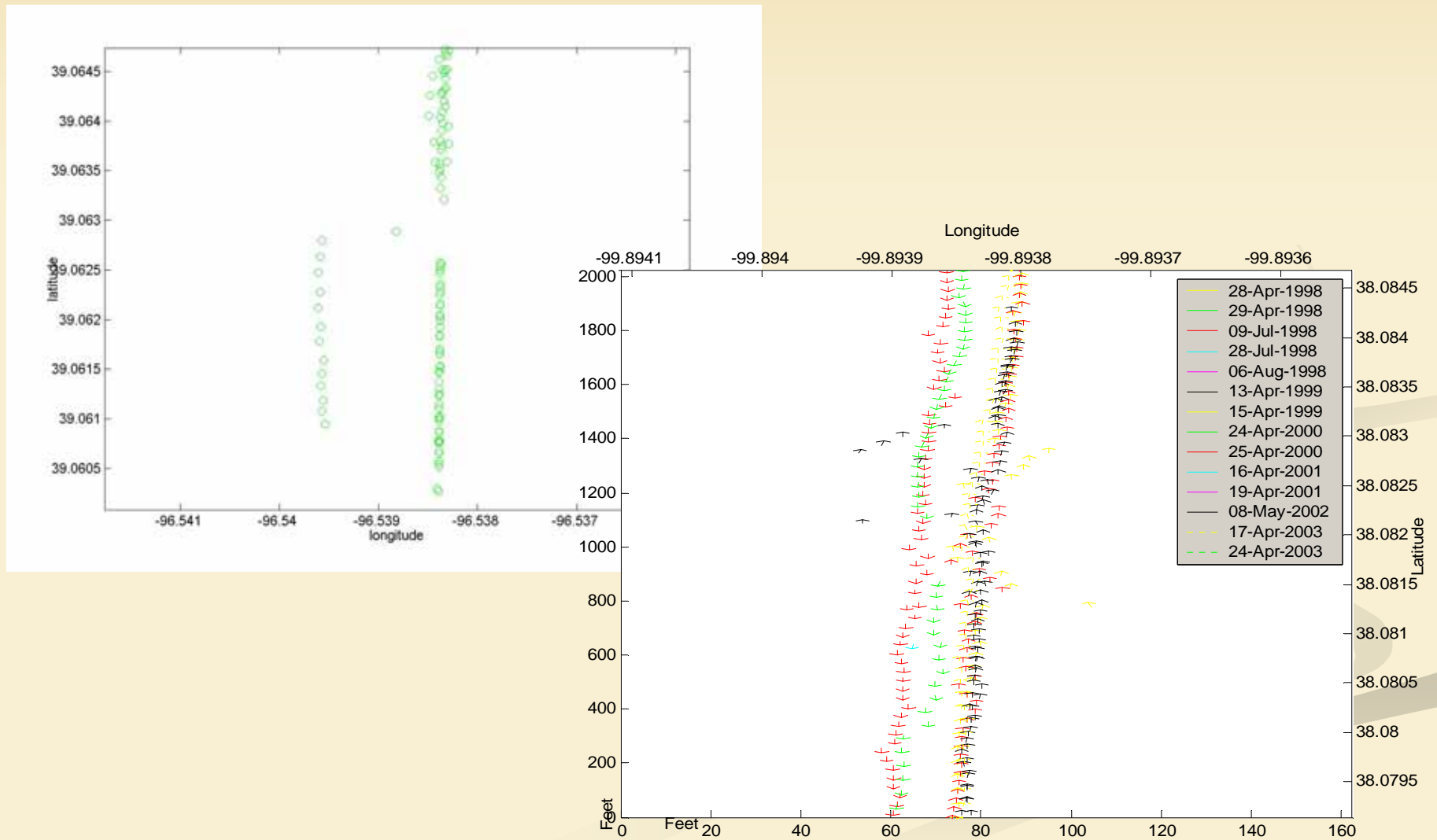


20 days data
Fix every 2 seconds

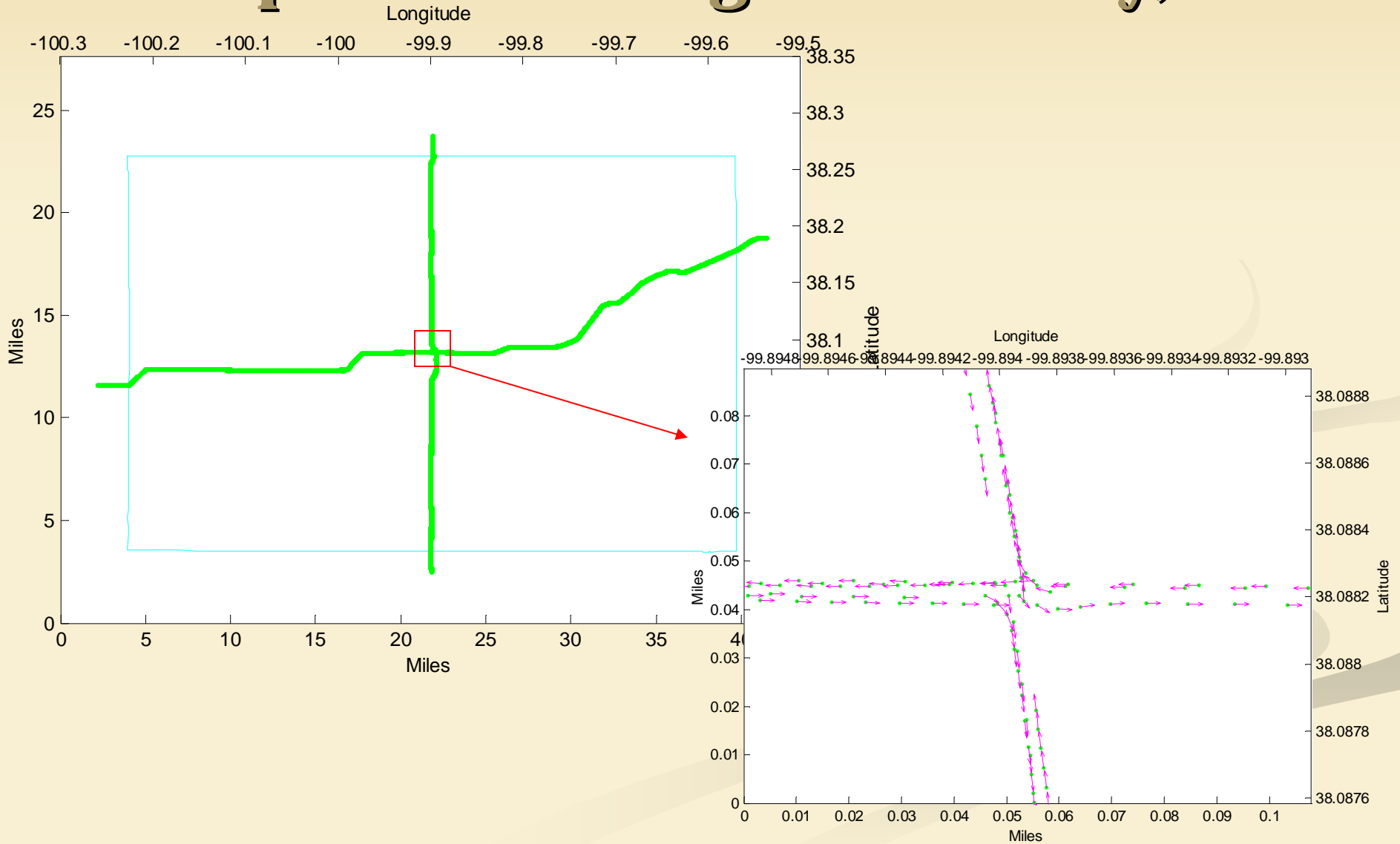
Vertical Data Sample 177 Riley



Example of Outliers



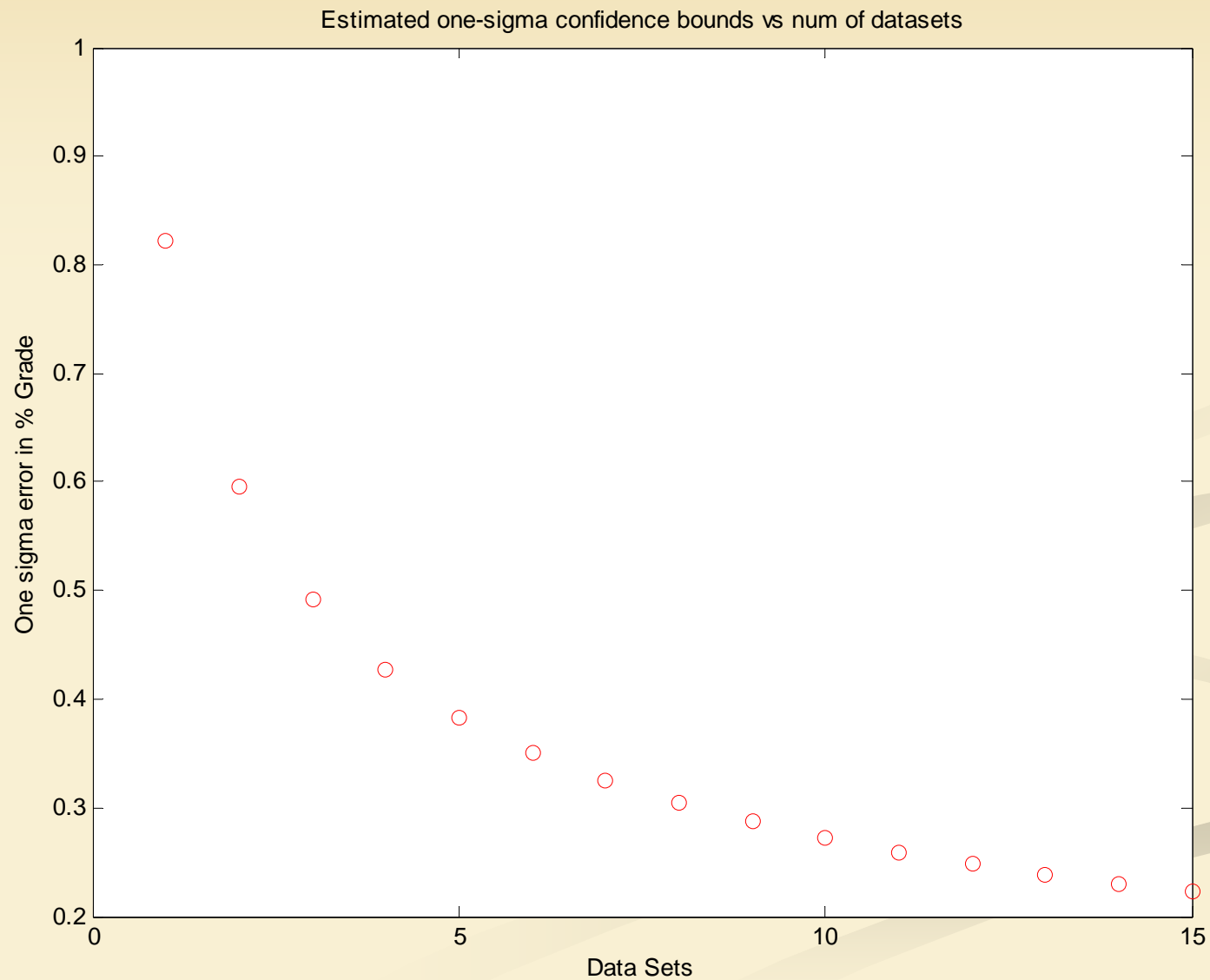
Sample Data - Hodgeman County, KS



Modeling Objectives

- Geometric – position, direction, grade
- Maximize spatial accuracy
- Any source of spatial data can be used
- Characterize accuracy as part of the model
- Increase accuracy with more data

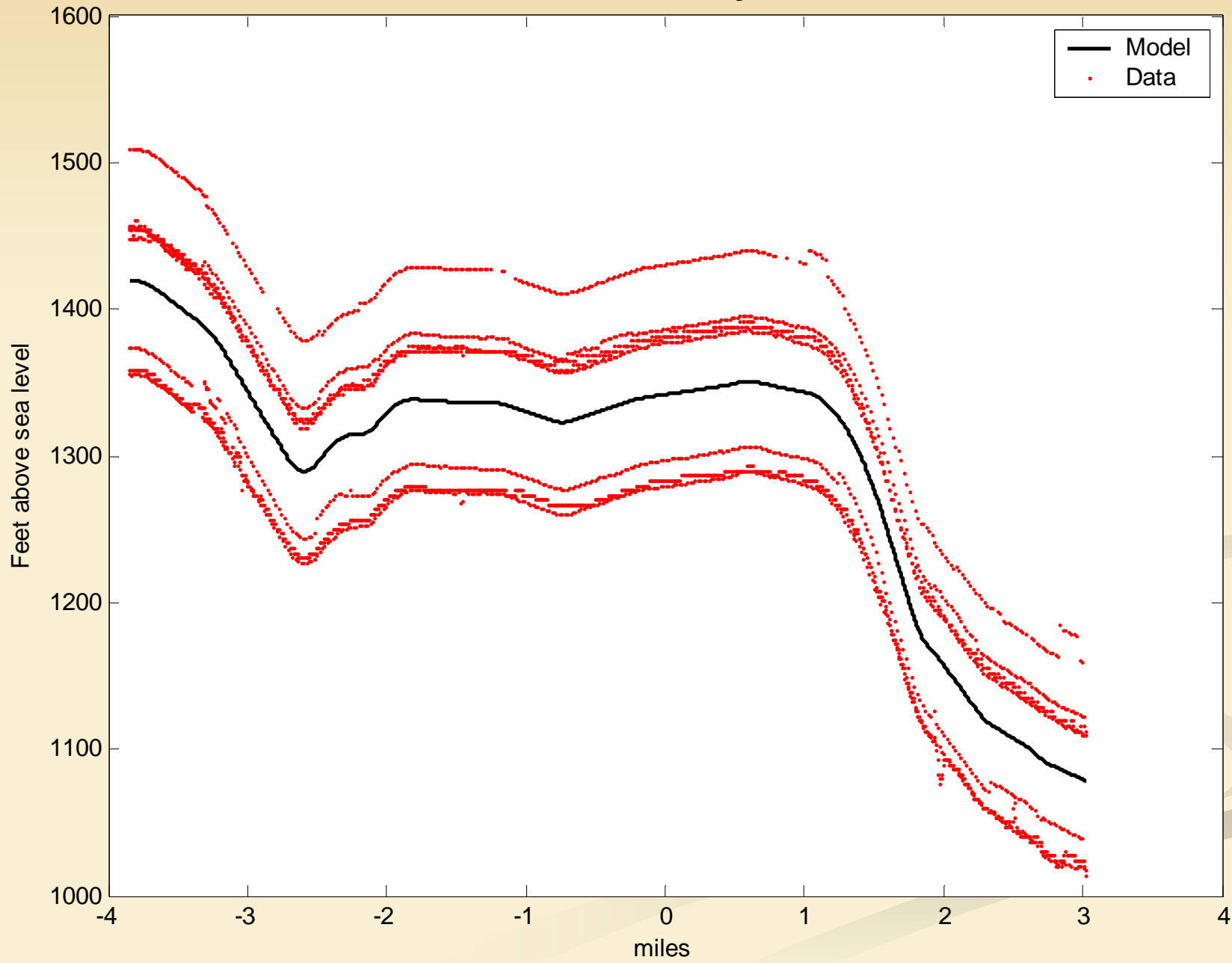
Anticipated Accuracy of Grade @ 0.99



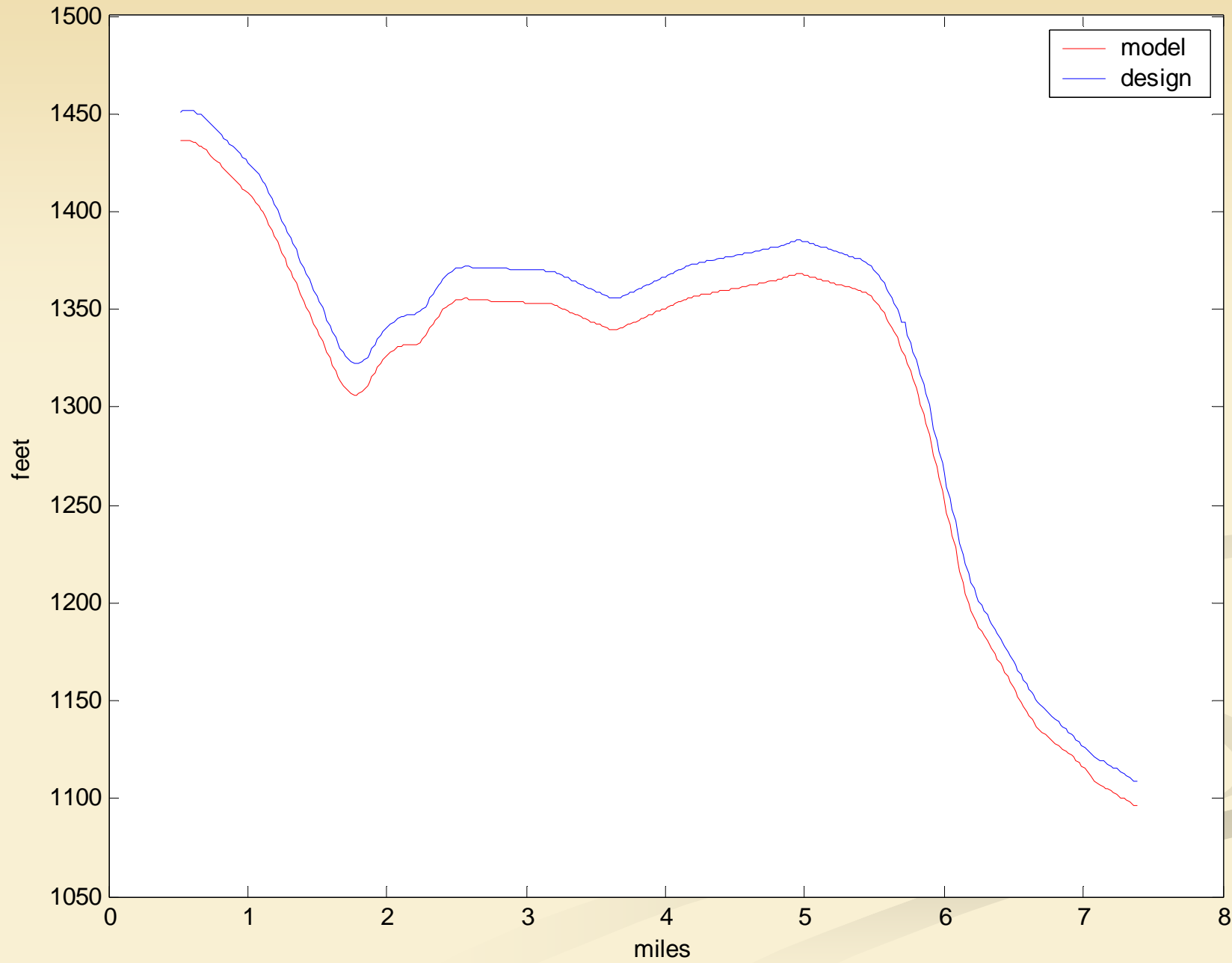
Principles of Modeling Algorithm

- Normalized low-order piece-wise polynomials
- Fit data and slope
- Robust, iterative curve fitting methodology
- Bias estimation and cancellation
- Estimate model accuracy from residual spread and coefficient error

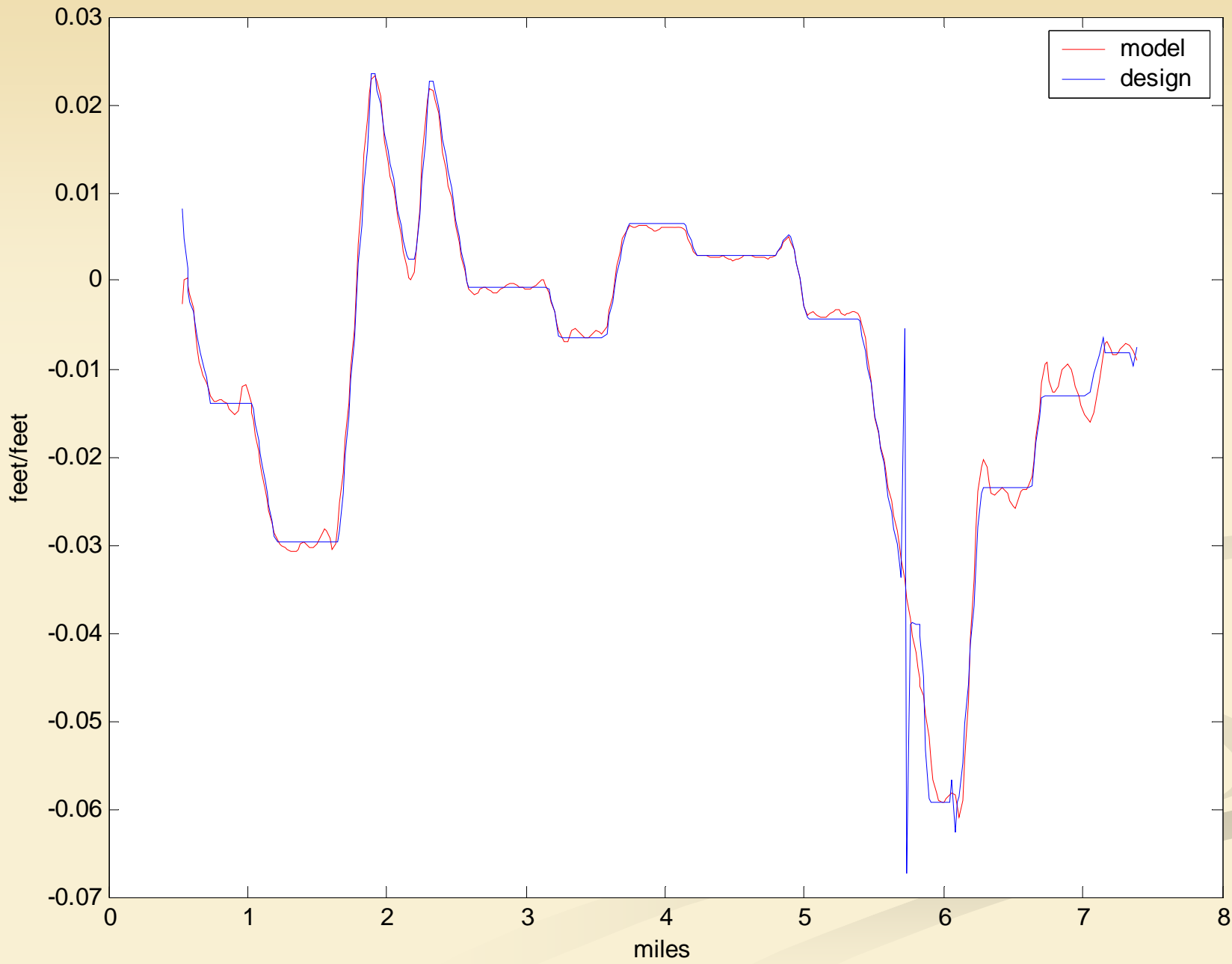
K177 - Elevation Fitting Results



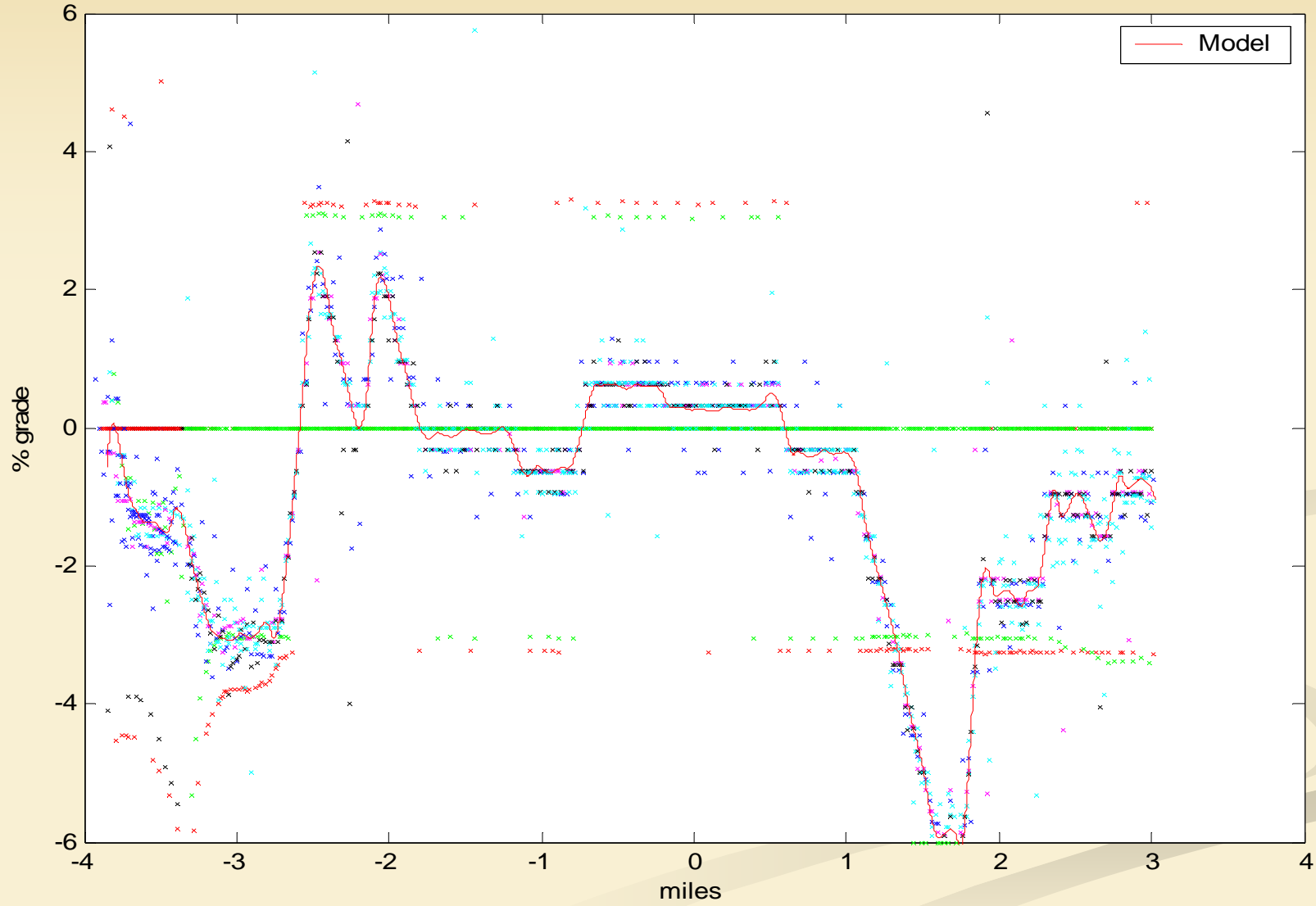
K177 - Elevation Profile



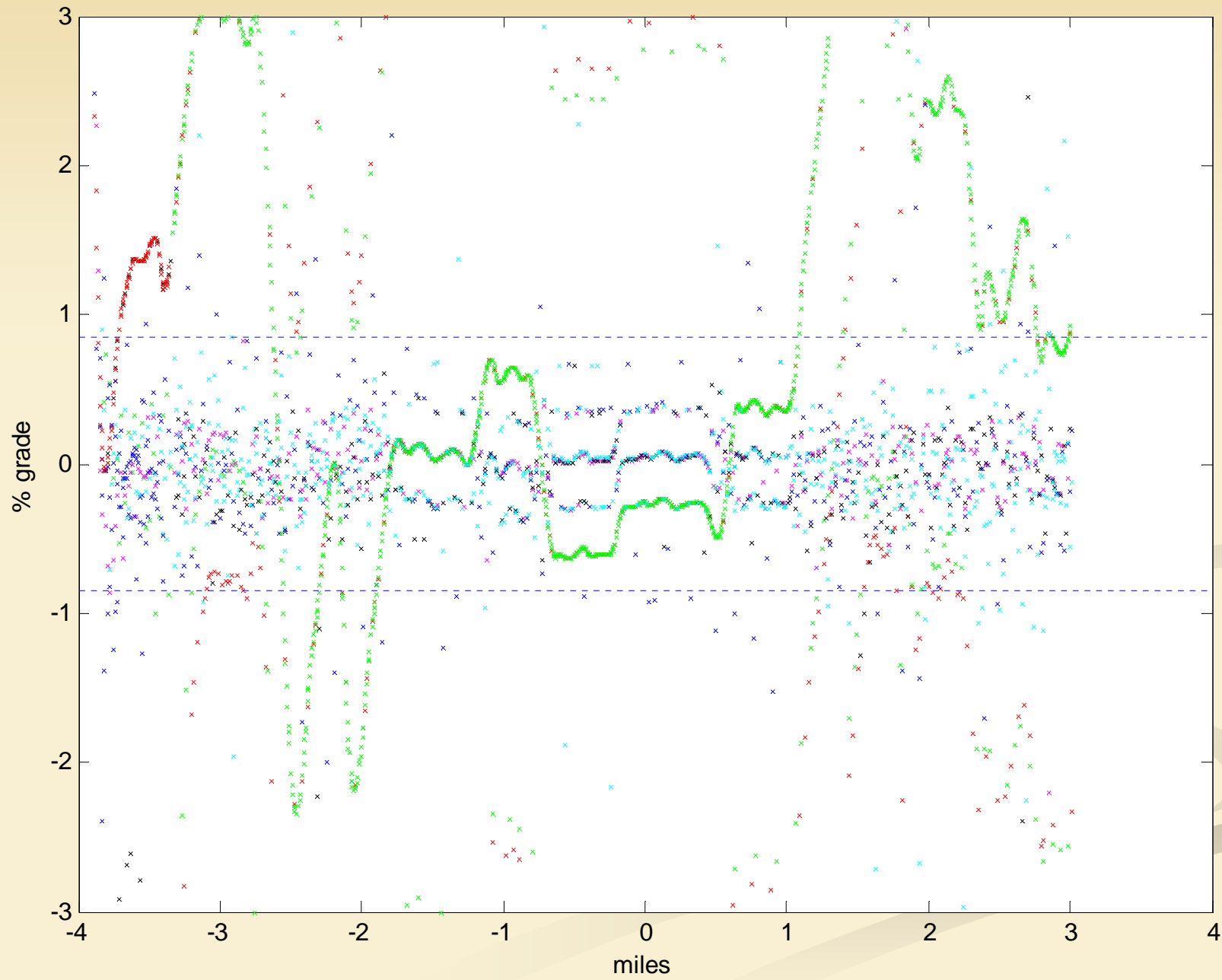
K177 - Grade Profile



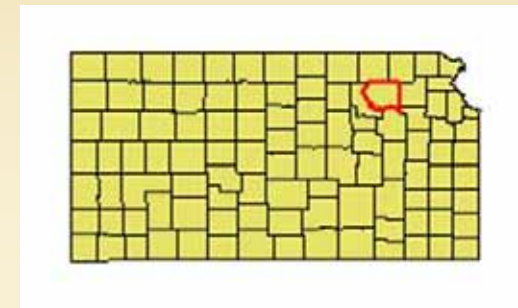
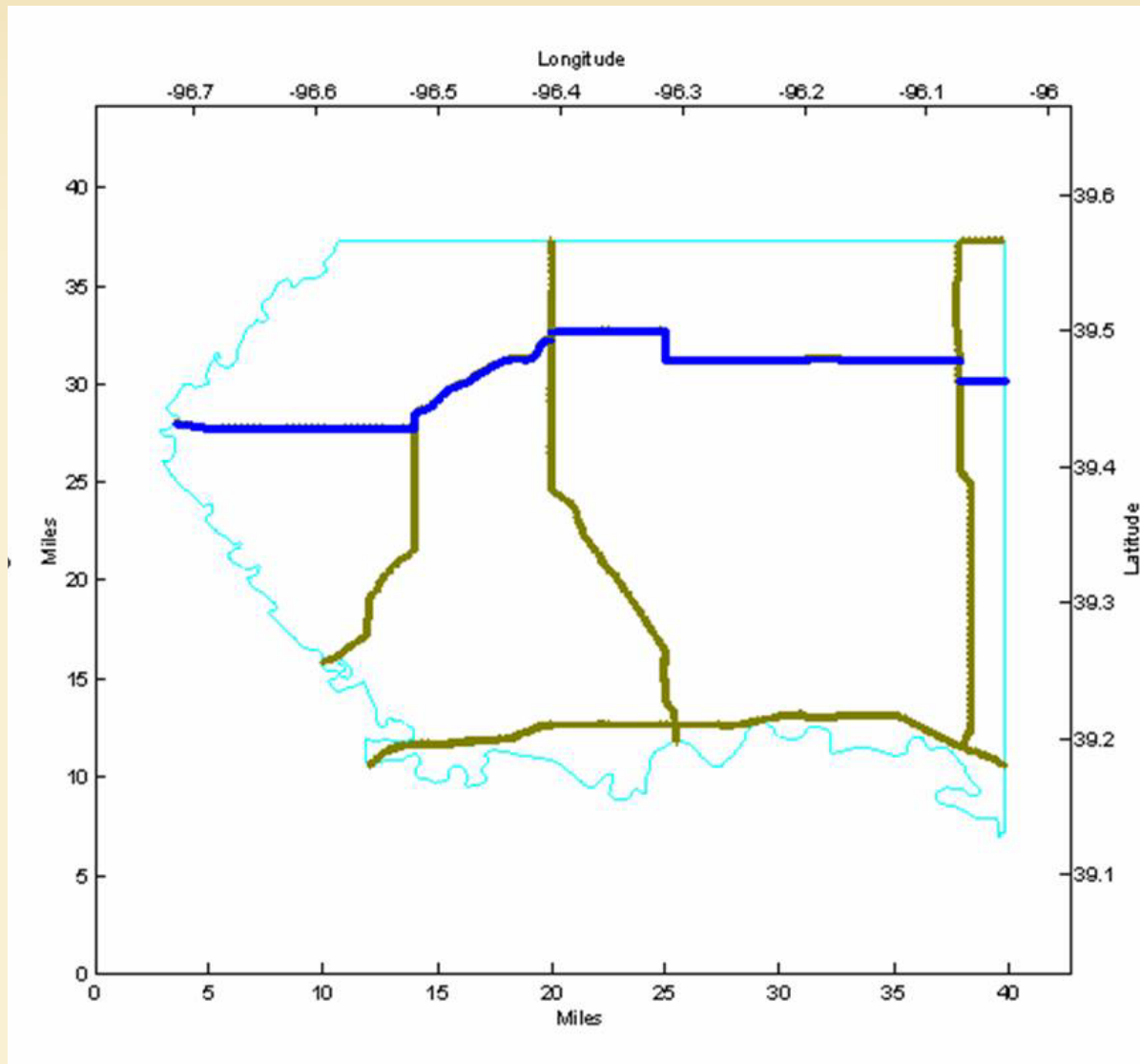
K177 - Grade Fitting Results



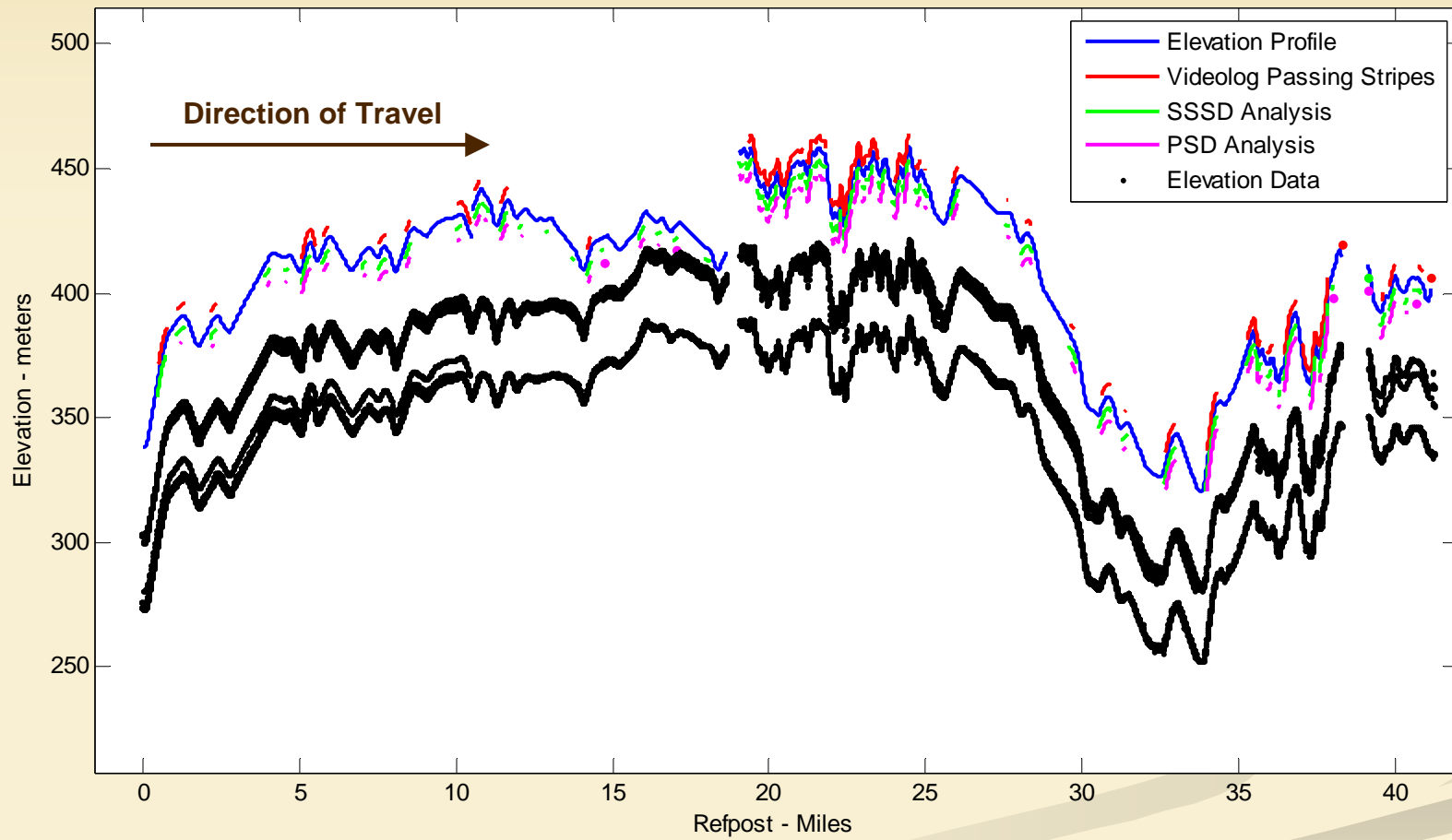
K177 - Grade Residual Plot

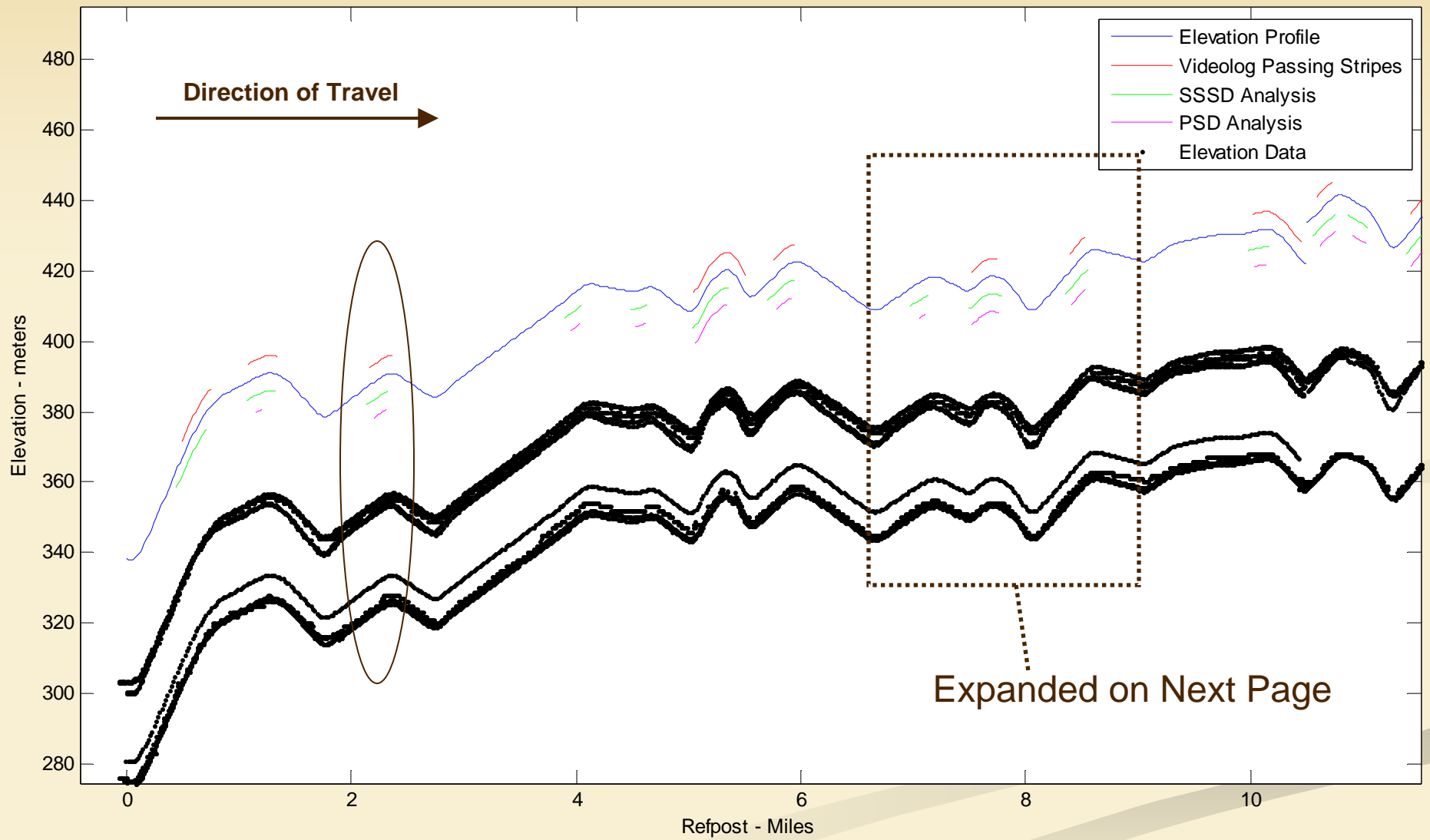


K16 Pottawatomie County [75]

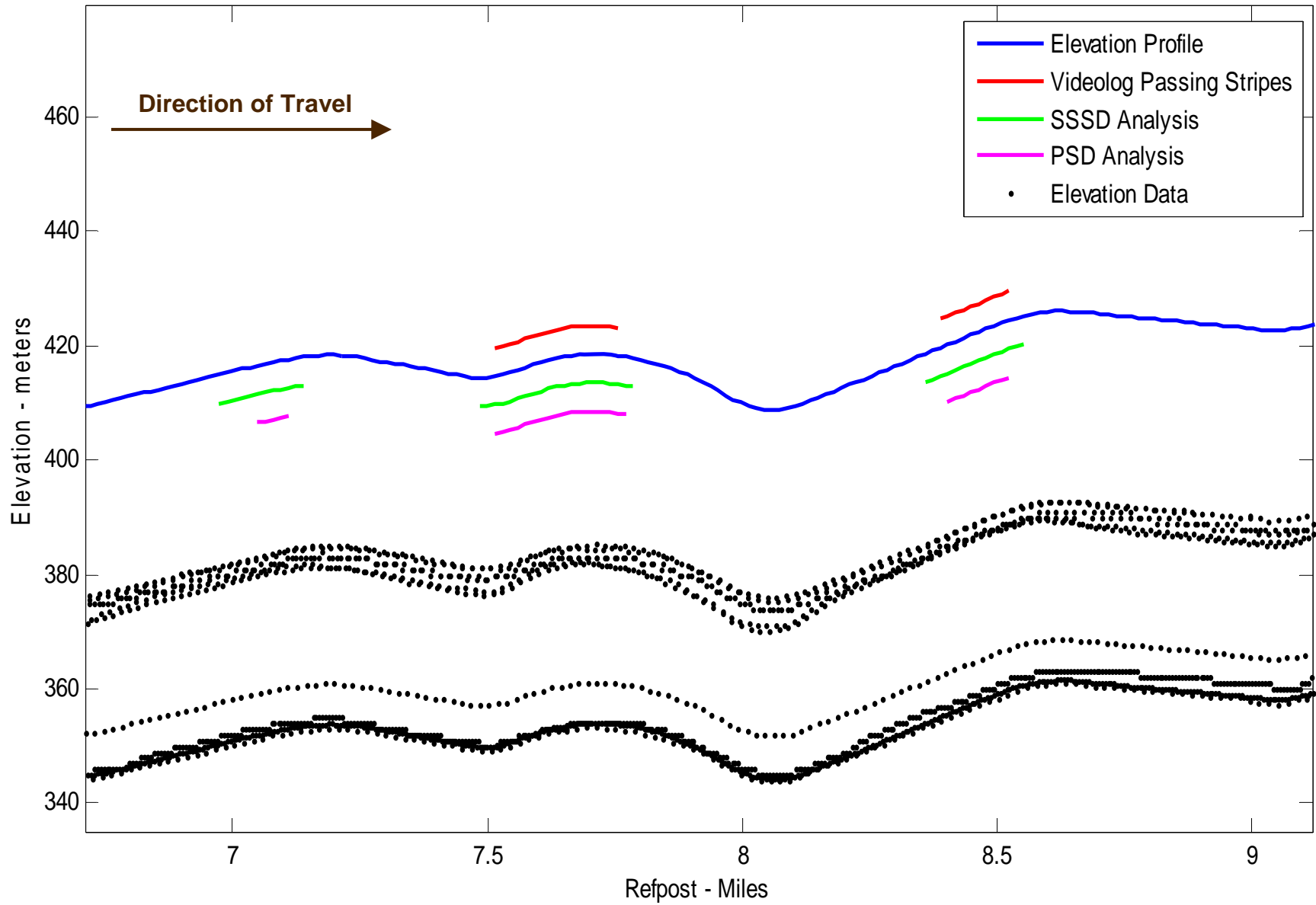


Route 16 in County #75 - Analysis of Elevation Profile





Route 16 in County #75 - Analysis of Elevation Profile



Summary

- Geometric Models based on Multi-run, Multi-year GPS Data
- Accuracy is established by relative agreement between data sets
- Applications
 - Sight Distance Analysis
 - LRS Transformations
 - Access Permit Evaluation