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M_{split} estimation as a method for processing heterogeneous data

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Introduction

M_{split} estimation

- The basic assumption: an observation set is a mixture of realizations of at least two different random variables. In other words: the observation set might consist of varying observation groups, which differ from each other in location parameters.
- The main objective of the method: to assess such parameters as different versions of the split functional model parameters.

Purpose of presentation

Processing heterogeneous data, namely point clouds obtained from LiDAR systems, by applying M_{split} estimation. It is assumed that data contain some disturbing points resulting from measurements of different objects, not the study object.

Simulated data

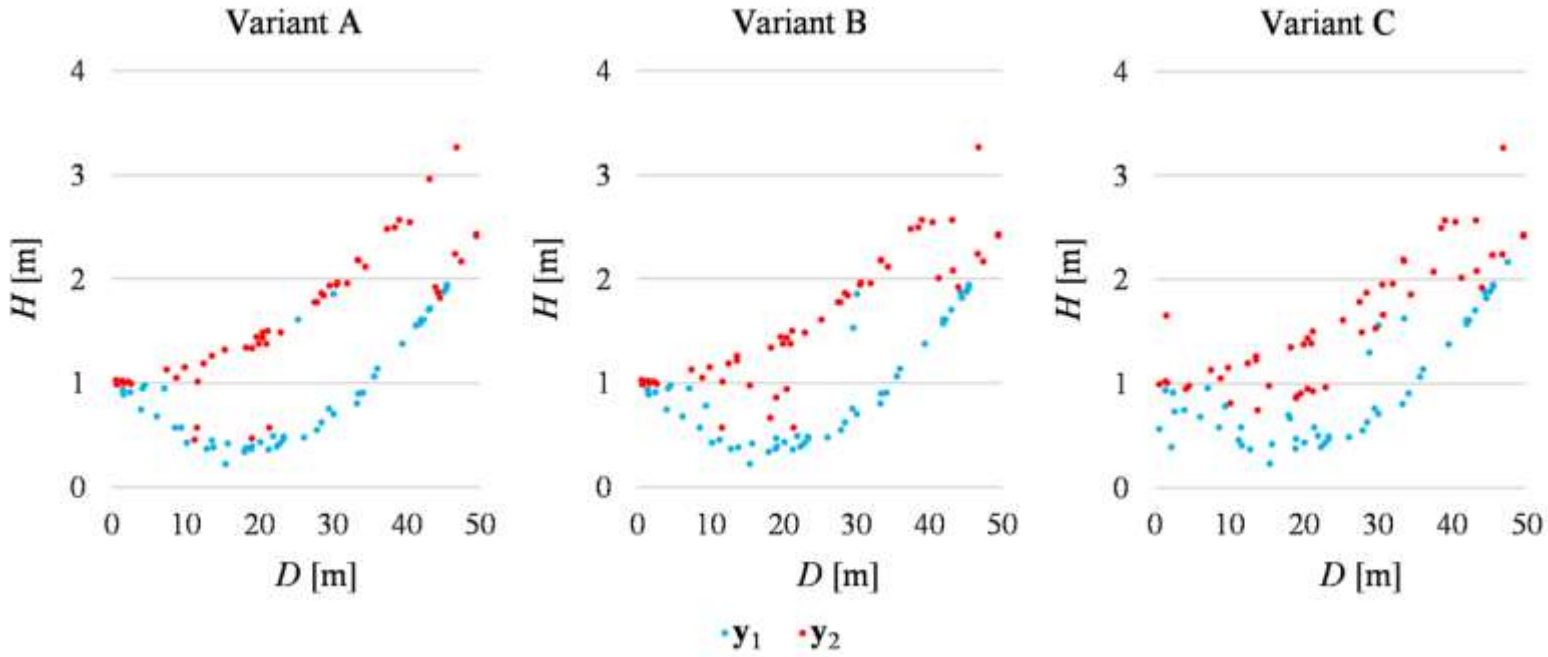

Fig. 1. Simulated observation sets in Variants A, B, and C:
A – observation set free of outliers, B – 10% of outliers within the observation set, C – 30% of outliers within the observation set

Results

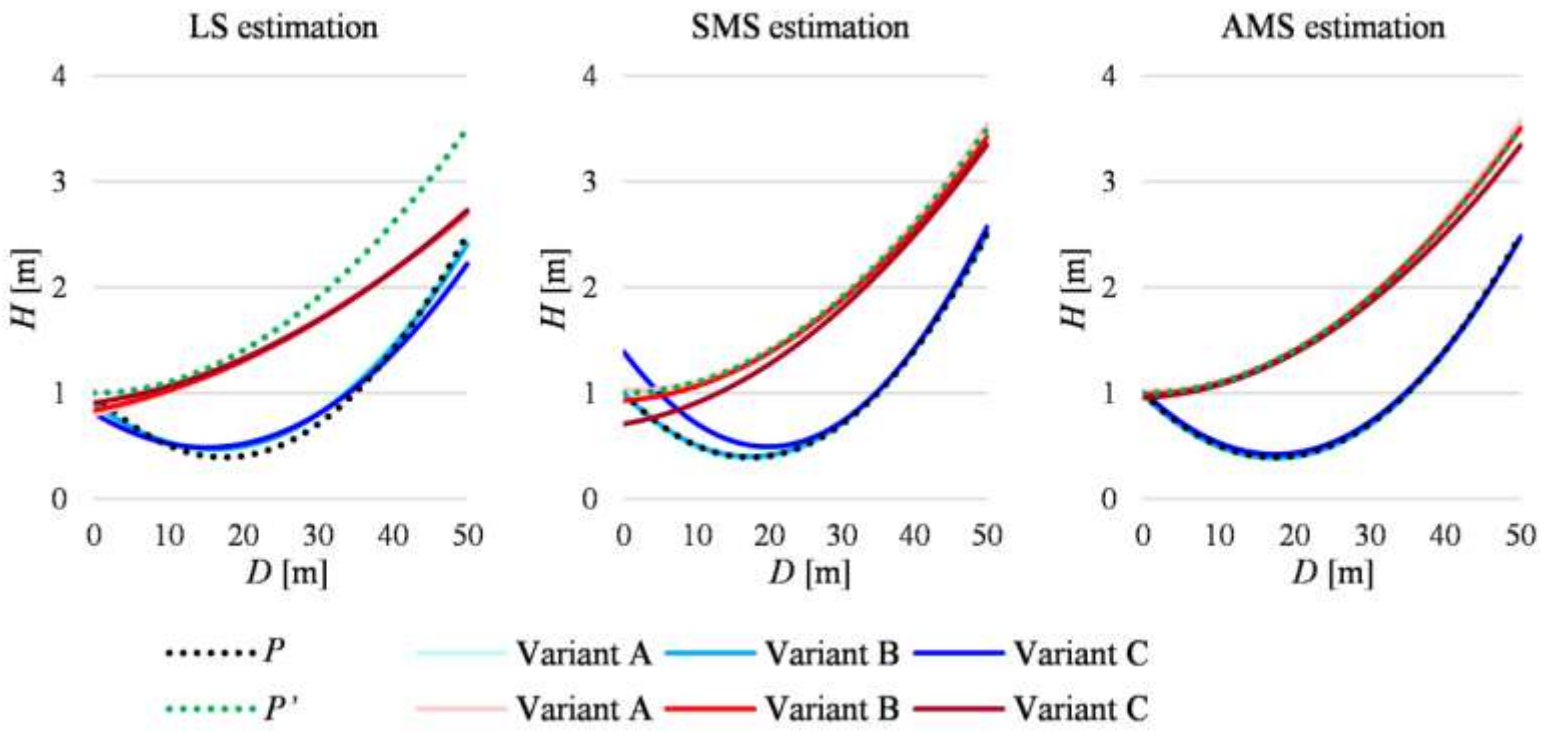

Fig. 2. Simulated and estimated profiles of terrain (*P*) and vegetation cover (*P'*)

LS – least squares estimation

SMS – squared M_{split} estimation, AMS – absolute M_{split} estimation

Simulated data

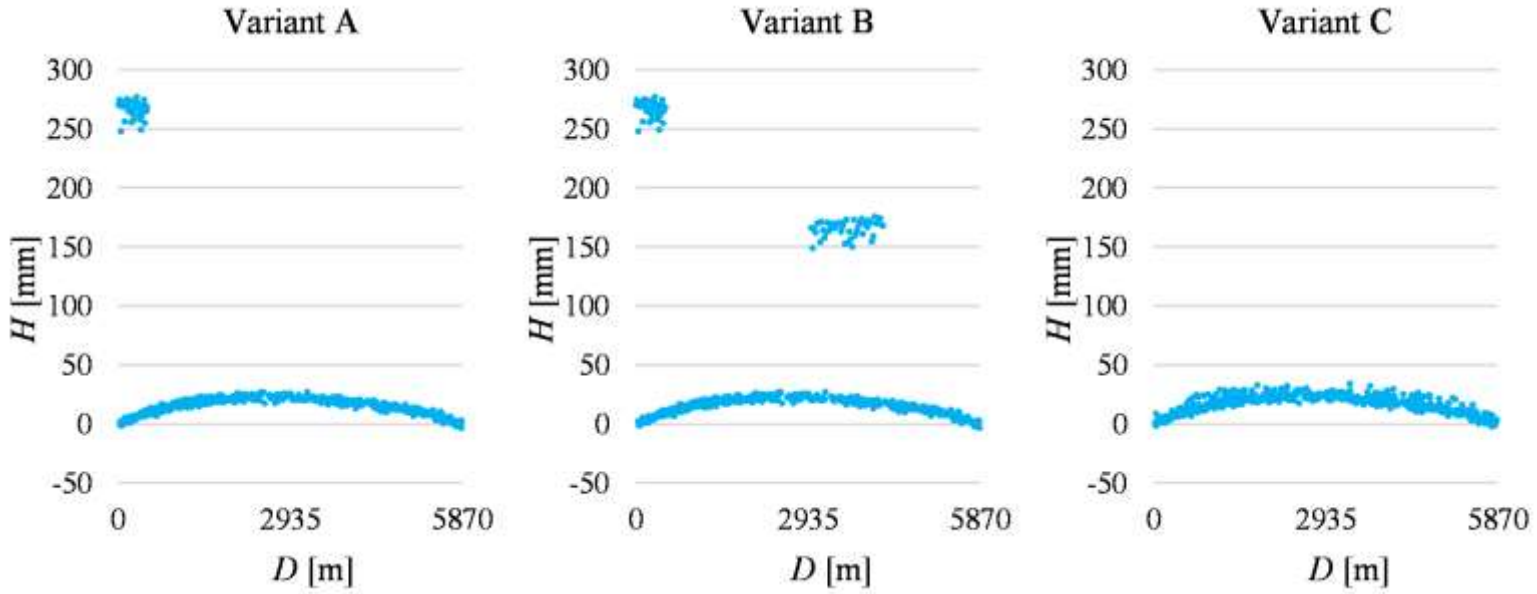

Fig. 3. Simulated observation sets in Variants A, B, and C:

Variant A – one group of 50 outliers of high magnitudes within the observation set, Variant B – two groups of 50 outliers of high magnitudes within the observation set, Variant C – 20% of the beam observations are outliers of low or moderate magnitude

Results

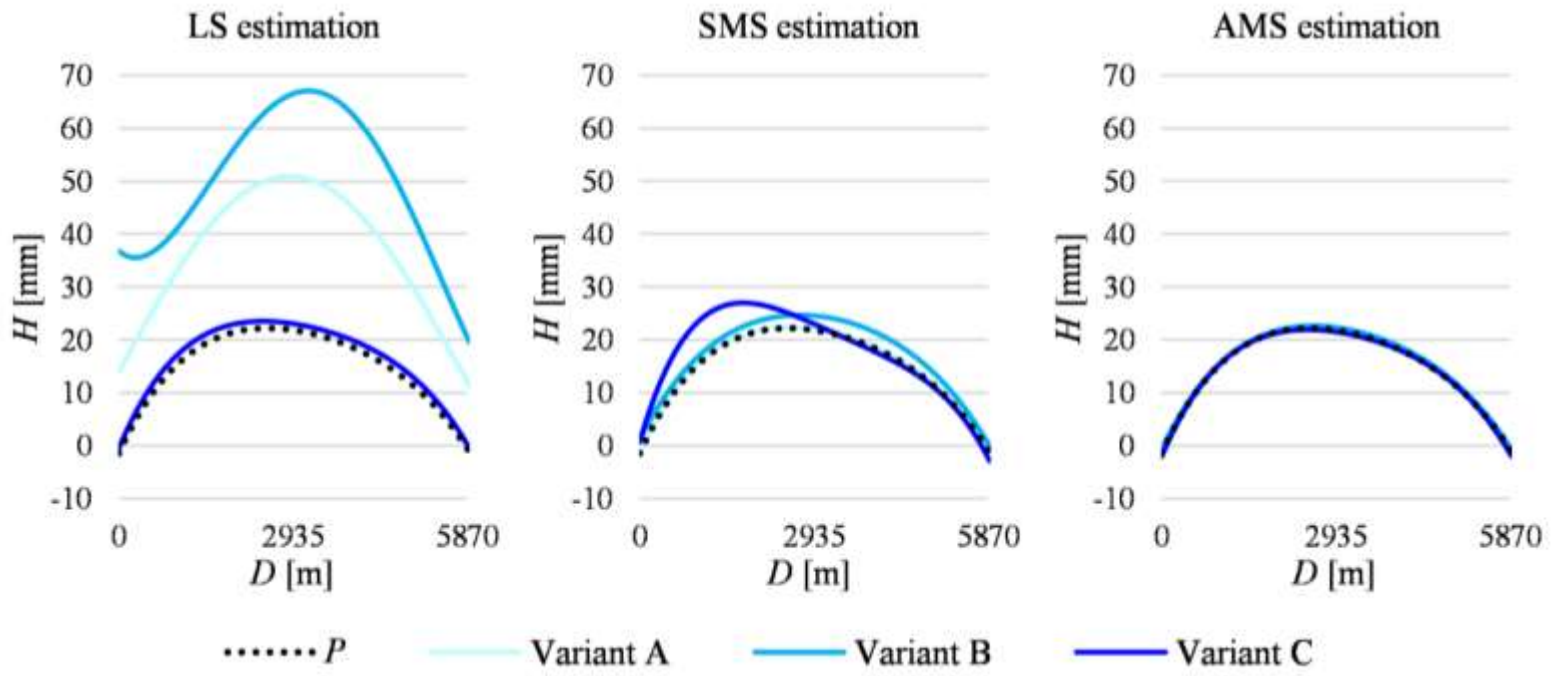

Fig. 4. Simulated profile *P* and estimated ones in Variants A, B, and C

LS – least squares estimation

SMS – squared M_{split} estimation, AMS – absolute M_{split} estimation

Summary and conclusions

- The paper concerns processing heterogeneous data from modern measurement techniques like LiDAR systems. Heterogeneity of observations results from measuring different objects, namely the study object and "obstacles." Heterogeneity of the observation data might also result from different accuracy of observation groups or occurrence of outlying observations.
- The first numerical example concerns estimating two versions of the functional model parameters, which is a natural approach in M_{split} estimation. The observation sets contain two main groups of observations: terrain measurements and vegetation cover measurements. The second numerical example concerns data, including the measurement of the study object and additional outlying observations. Hence, one is interested in estimating only one parameter version (describing the study object). The second solution of M_{split} estimation should be ignored as describing the location of outliers. In both examples, M_{split} estimation variants, especially AMS estimation can provide satisfactory results.
- Generally, M_{split} estimation can be recommended to process heterogeneous data consisting of two (or more) observation groups for which the functional model parameters are estimated.

Thank you for your attention