New results in the application of the machine-z method

Istvan I. Racz[1,2] (*racz@complex.elte.hu*), Dezső Ribli[1], Zsolt Bagoly [1,2], Istvan Csabai[1,2], Istvan Horvath[3], Lajos G. Balázs[1,2]

[1]Eötvös University, Budapest, [2]MTA CSFK Konkoly Observatory, Budapest, [3]National University of Public Service, Budapest

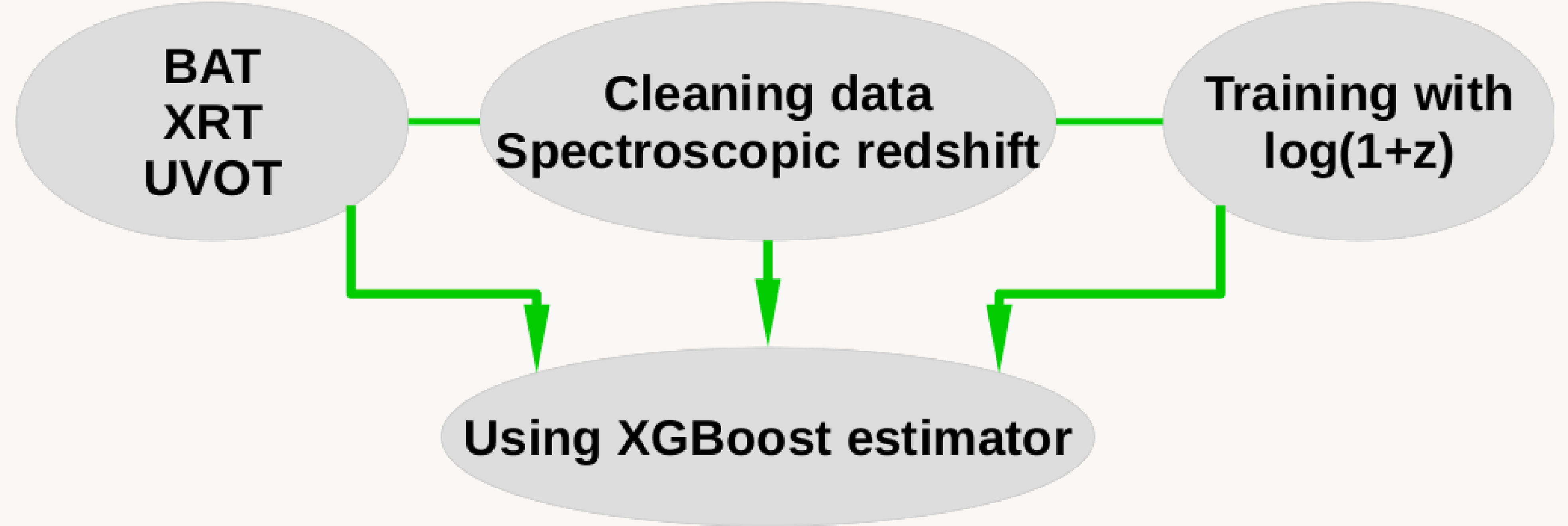
NATIONAL UNIVERSITY OF PUBLIC SERVICE

Overview

Several thousands of GRBs have been observed so far but we could measure the distance of only a few hundreds. We studied the parameters of GRBs with available spectroscopic redshift in order to be able to estimate the redshift of those GRBs without a measured redshift. To calculate their distances we applied the eXtreme Gradient Boosting (XGBoost) algorithm [Chen & Guestrin (2016)]. For the process we used selected gamma, x-ray and ultraviolet parameters from the the Swift GRB catalog, in which 328 GRBs had measured spectroscopic redshift. We found a significantly higher correlation (r=0.67) between the measured and estimated redshift than the state of art value of 0.57 (published by [Ukwatta et al. (2016)]).

Method: XGBoost

XGBoost is an advanced machine learning algorithm based on the decision tree method and uses "boosting" to improve a single weak model by combining it with a number of other weak models in order to generate a collectively strong model. We could improve the correlation:



Results

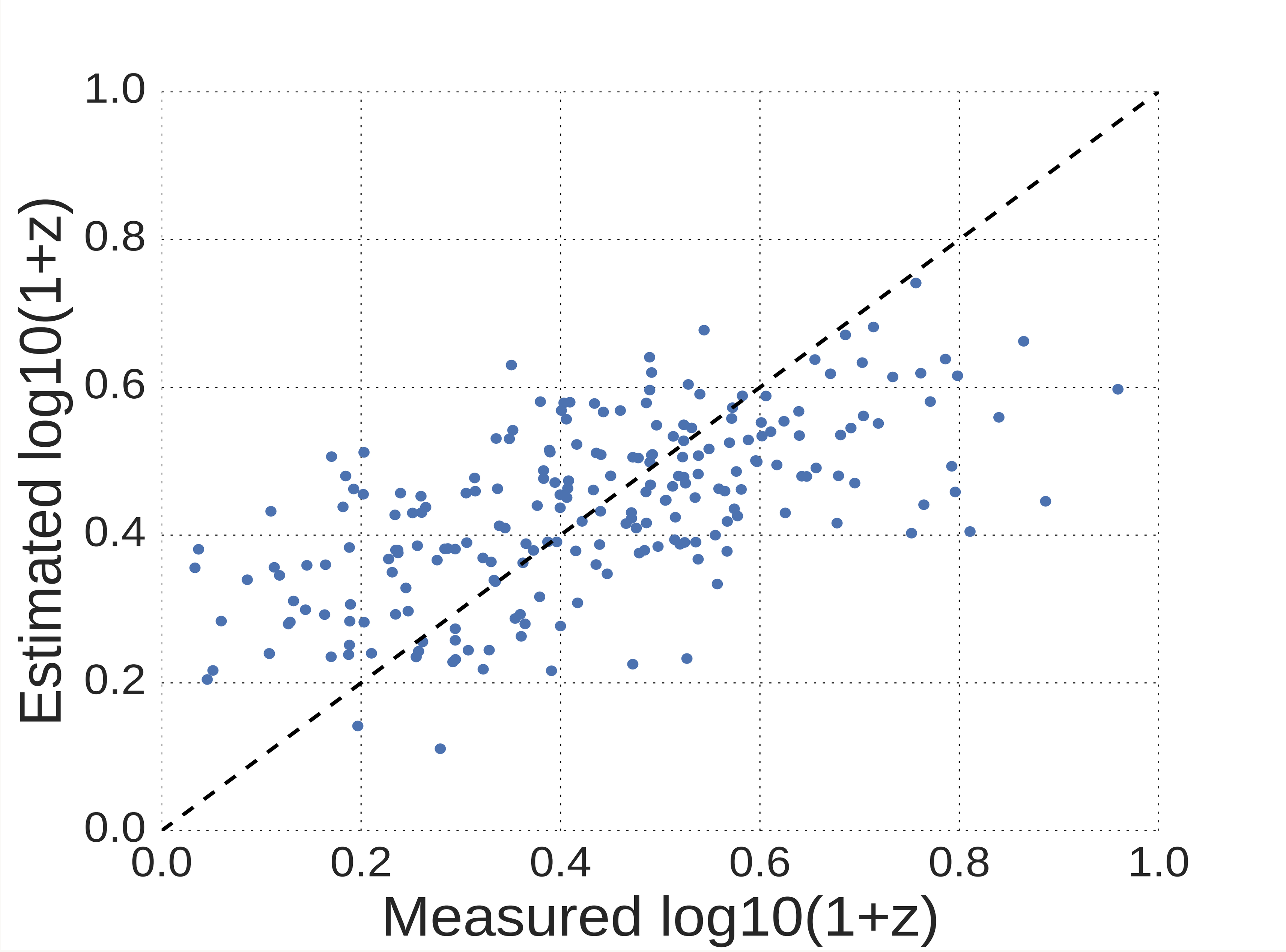


Fig. 1. We used the data of all three Swift instruments and sufficiently cleaned them. Using the log(l+z) data we could establish a 0.67 linear correlation between the estimated and measured redshifts.

Fig. 2. Transforming the results back to the true redshifts the correlation remained similarly good. Further improvement can be obtained by using new data points.

Summary

We examined the Swift BAT-XRT-UVOT data. Using the XGBoost estimator we could successfully improve the redshift estimations. The log(l+z) correlations improved between the measured and calculated data to 0.67.

Acknowledgements This work was supported by the Hungarian OTKA NN-111016 grant. Supported by the Hungarian ÚNKP-17-3 New National Excellence Program of the Ministry of Human Capacities.

Bibliography

Ukwatta, T. N., Woźniak, P. R., & Gehrels, N. 2016, MNRAS, 458, 3821

Chen, T., & Guestrin, C. 2016, Proc. of the 22nd ACM SIGKDD Int. Conf. on Knowledge Discovery and Data Mining (KDD '16), 785-794