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Improving Photometric Redshifts by Merging Probability Density Functions from Template-Based and Machine Learning Algorithms[1]

© 2022 г. I. Y. K. Alshuaili[1], J. Y. H. Soo[1*], M. Z. M. Jafri[1], Y. Rafid[1]

[1] *School of Physics, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia*

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Abstract—This study aims to improve the photometric redshifts (photo-zs) of galaxies by integrating two contemporary methods: template-fitting and machine learning. Finding the synergy between these two methods was not a high priority in the past, but now that our computer processing power and observational accuracy have increased, we deem it worth investigating. We compared two methods to improve galaxy photometric redshift estimations by using the algorithms ANNz2 and BPz on different photometric and spectroscopic samples from the Sloan Digital Sky Survey (SDSS). We find that the photometric redshift performance of ANNz2 (machine learning) is better than that of BPz (galactic templates), and with the utilization of the merging technique we introduced, we see that there is an improvement in photo-z when the two strategies are consolidated, providing improvements in $\boldsymbol{\sigma}_{\mathrm{RMS}}$ and $\boldsymbol{\sigma}_{68}$ up to [0.0265 & 0.0222] in LRG sample and [0.0471 & 0.0471] in the Stripe-82 sample. This simple demonstration can be used for photo-zs of galaxies in fainter and deeper sky surveys, and future work is required to prove its viability in these samples.

Keywords: Galaxies: distances and redshifts Methods: photometric methods: data analysis.

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СПИСОК ЛИТЕРАТУРЫ

1. J. Y. H. Soo, Ph. D. Thesis (University College London, 2018).
2. A. J. Connolly, csabai, a. S. Szalay, et al., Astron. J. **110**, 2655c (1995).
3. Y. Wang, N. Bahcall, E. L. Turner, arXiv:9906256V1 (1998).
4. E. Vanzella, S. Cristiani, A. Fontana, M. Nonino, and S. Arnouts, et al., Astron. Astrophys. **423**, 761 (2003).
5. R. Beck, C.-A. Lin, E. E. O. Ishida, et al., Mon. Not. R. Astron. Soc. **468**, 4323B (2017).
6. D. G. York, J. Adelman, J. E. Anderson, et al., Astron. J. **120**, 1579 (2000).
7. J. A. Newman, D. Gruen., Annu. Rev. Astron. Astrophys. **60**, 363 (2022).
8. Abdurro'uf, K. Accetta, C. Aerts, V. A. et al., Astrophys. J. **259**, 35 (2022).
9. J. Gunn, M. Carr, C. Rockosi, et al. Astron. J. **116**, 3040 (2020).
10. D. J. Eisenstein, D. H. Weinberg, E. Agol, H. Aihara, et al., Astron. J. **142**, 24 (2011).
11. K. Abazajian, et al., Astrophys. J. **182**, 543 (2009).
12. A. E. Firth, O. Lahav, R. Somerville, Mon. Not. R. Astron. Soc. **339**, 1195 (2003).
13. W. A. Baum, IAU Symp. **15**, 390 (1962).
14. S. A. Butchins, Astron. Astrophys. 97, 407 (1981).
15. B. Massimo, C. Stefano, R. Oleksandra, A. Valeria, R. Giuseppe and L. Giuseppe. 8: 658229 (2021)
16. I. Sadeh, F. B. Abdalla, and O. Lahav. Pub. Astron. Soc. Pac.128.968: 104502 (2016).
17. M.Bilicki, H. Hoekstra, M. J. I. Brown, V. Amaro, C. Blake, et al., Astron. Astrophys. **616**, A69 (2018).
18. N. Benitez, Astron. J. **536**(2), 571 (2000).
19. O. Ilbert, S. Arnouts, H.J. McCracken, M. Bolzonella, E. Bertin, O. Le Fèvre, et al., Astron. Astrophys. **457**(3), 841 (2006).
20. T. Abbott, G. Aldering, J. Annis, M. Barlow, C. Bebek, et al. arXiv: 0510346 (2005)
21. M. J. Brown, J. Moustakas, J. D. Smith, E. Da Cunha, T.H. Jarrett, et al., Astrophys. J. **212**(2), 18 (2014).

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[*] E-mail: johnsooyh@usm.my

22. G. D. Coleman, C. C. Wu, D.W. Weedman, Astrophys. J. **43**, 393 (1980).
23. A. L. Kinney, D. Calzetti, R. C. Bohlin, K. McQuade, T. Storchi-Bergmann, H. R. Schmitt, Astrophys. J. **467** 38 (1996).
24. G. Bruzual, S. Charlot, Mon. Not. R. Astron. Soc. **344**(4), 1000 (2003)
25. M. Polletta, M. Tajer, L. Maraschi, G. Trinchieri, C. J. Lonsdale, L. Chiappetti, et al., Astrophys. J. **663**(1), 81 (2007).
26. Z. Ivezić, S. M.Kahn, J. A. Tyson, B. Abel, E. Acosta, R. Allsman, et al., Astrophys. J. **873**(2), 111 (2019).
27. C. Padilla, F. J. Castander, A. Alarcón, J. Aleksic, O. Ballester, et al., Astrophys. J. **157**(6), 246 (2019).
28. http://www.sdss.org/. Accessed June 5, 2022.
29. A. V. Meshcheryakov, V. V. Glazkova, S. V. Gerasimov, et al., Astron. Lett. **41**(7), 307 (2016).
30. F. B. Abdalla, M. Banerji, O. Lahav, V. Rashkov. Mon. Not. R. Astron. Soc. **417**, 1891 (2011).