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Einstein Telescope: binary black holes gravitational wave signals detection from three detectors combined data using deep learning

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Continuing from our prior work \citep{10.1093/mnras/stac3797}, where a single detector data of the Einstein Telescope (ET) was evaluated for the detection of binary black hole (BBHs) using deep learning (DL). In this work we explored the detection efficiency of BBHs using data combined from all the three proposed detectors of ET, with five different lower frequency cutoff (F_{low}): 5 Hz, 10 Hz, 15 Hz, 20 Hz and 30 Hz, and the same previously used SNR ranges of: 4-5, 5-6, 6-7, 7-8 and >8. Using ResNet model (which had the best overall performance on single detector data), the detection accuracy has improved from 60%, 60.5%, 84.5%, 94.5% and 98.5% to 78.5%, 84%, 99.5%, 100% and 100% for sources with SNR of 4-5, 5-6, 6-7, 7-8 and >8 respectively. The results show a great improvement in accuracy for lower SNR ranges: 4-5, 5-6 and 6-7 by 18.5%, 24.5%, 13% respectively, and by 5.5% and 1.5% for higher SNR ranges: 7-8 and >8 respectively. In a qualitative evaluation, ResNet model was able to detect sources at 86.601 Gpc, with 3.9 averaged SNR (averaged SNR from the three detectors) and 13.632 chirp mass at 5 Hz. It was also shown that the use of the three detectors combined data is appropriate for near-real-time detection, and can be significantly improved using more powerful setup.

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