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Convolutional neural network search for long-duration transient gravitational waves from glitching pulsars

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Machine learning can be a powerful tool to discover new signal types in astronomical data. In our recent study, we have applied it for the first time to search for long-duration transient gravitational waves triggered by pulsar glitches, which could yield physical insight into the mostly unknown depths of the pulsar. Other methods previously applied to search for such signals rely on matched filtering and a brute-force grid search over possible signal durations, which is sensitive but can become very computationally expensive. We have developed a new method to search for post-glitch signals on combining matched filtering with convolutional neural networks, which reaches similar sensitivities to the standard method at false-alarm probabilities relevant for practical searches, while being significantly faster. We specialize to the Vela glitch during the LIGO-Virgo O2 run, and present new upper limits on the gravitational-wave strain amplitude from the data of the two LIGO detectors for both constant-amplitude and exponentially decaying signals.

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