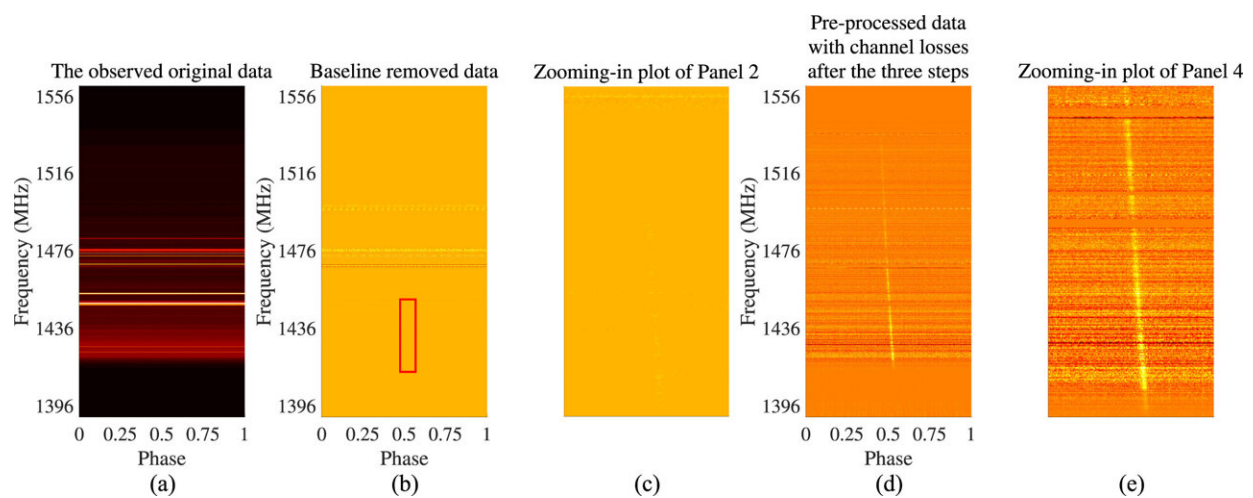


Proposed method for radio-frequency interference mitigation and signal restoration of pulsar signals

October 10 2022, by Li Yuan



The three-step preprocessing of PSR J1645-0317. (a) The observed original data. (b) Channel saturation and huge-amplitude RFI after baseline removal of Step 1. (c) Zooming-in details of the red rectangle in panel (b). Only an extremely weak signal portion can be identified by visual inspection. (d) Profile F with channel losses after Steps 2 and 3 with $\gamma = 30$. (e) Zooming-in details of panel (d). Credit: *The Astrophysical Journal* (2022). DOI: 10.3847/1538-4357/ac8003

Pulsar signals obtained with radio telescopes are extremely weak. Generally, there are two primary difficulties in pulsar signal processing—one is the radio-frequency interference (RFI) mitigation, and the other one is information loss due to the preprocessing and

mitigation itself.

Therefore, the [innovations](#) in RFI elimination method are meaningful to carry out further studies on the astronomical measurements, such as [pulsar](#) timing.

Using pulsar data collected by the NanShan 26-m Radio Telescope (NSRT) from 2011 to 2014, researchers from the Xinjiang Astronomical Observatory (XAO) of the Chinese Academy of Sciences have proposed a novel method called "CS-Pulsar," which carries out compressed sensing (CS) on time-frequency signals to accomplish RFI mitigation and signal restoration simultaneously.

The wavelet transform and discrete cosine transform were applied as a sparse promoting term to aid the optimization. Results showed that the sensing mechanism performed better in signal restoration for the preprocessed channels, and played a positive role in mitigating "on pulse" RFI.

In an application of pulsar timing, no systematic biases or underestimated uncertainties were caused. This method can improve the timing accuracy to a certain extent by reducing the timing residuals and the estimated errors.

The results were published in *The Astrophysical Journal*.

More information: Hao Shan et al, Compressed Sensing Based RFI Mitigation and Restoration for Pulsar Signals, *The Astrophysical Journal* (2022). [DOI: 10.3847/1538-4357/ac8003](https://doi.org/10.3847/1538-4357/ac8003)

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