Pulsar Period Detection for Grid Synchronization using Fast Folding Algorithm

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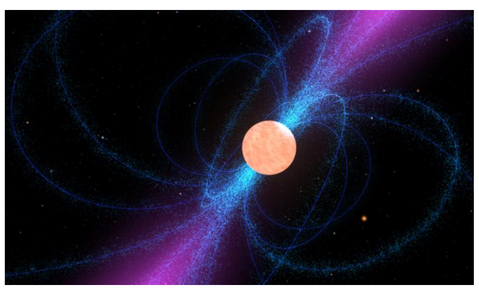
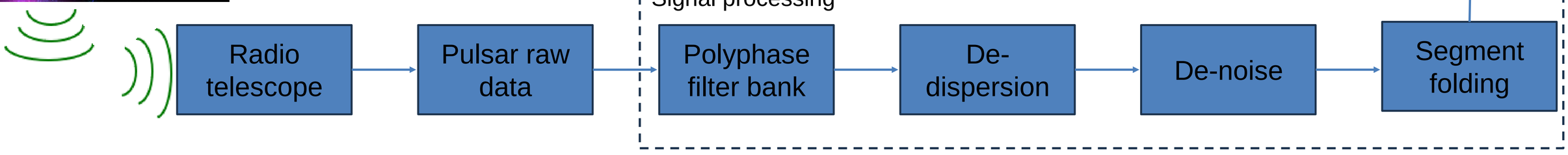
INTRODUCTION

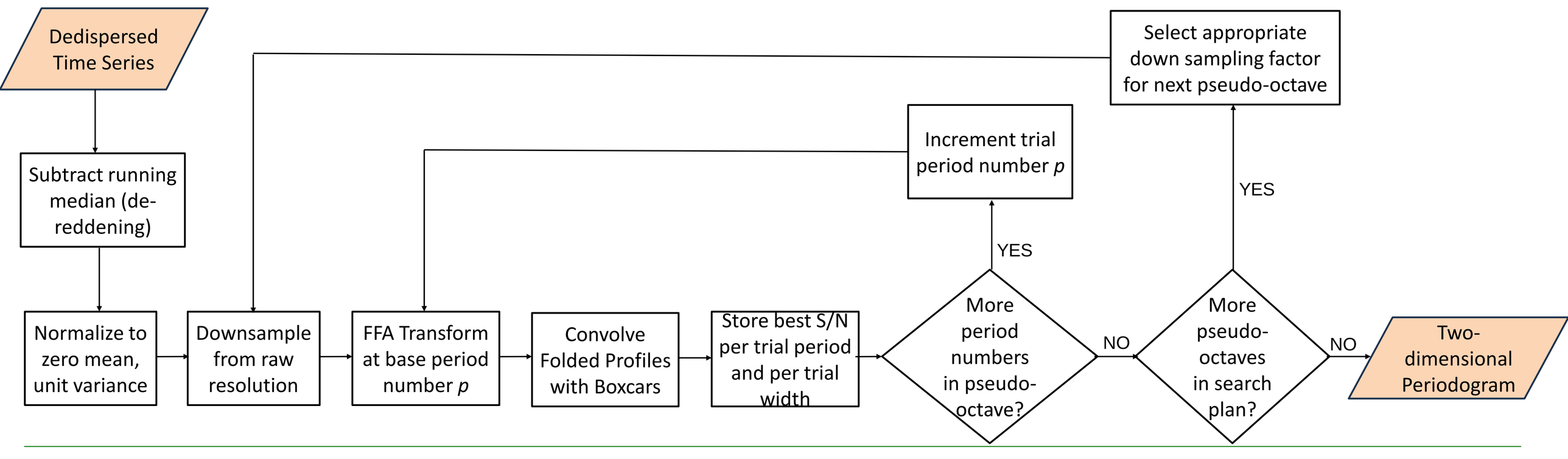
- When the timing security and reliability of GPS are threatened by various factors, Pulsar-based Timing System (PBTS) can be the substitute.
- The pulsar signal received cannot be used directly, because of the noise, interference, and dispersion effect by interstellar medium, the signal need to be processed to obtain pulse period.
- To continuously utilize the pulsar signal in grid synchronization, the signal processing should be efficient and accurate to achieve real time timing.
- This work introduces the fast-folding algorithm(FFA) to process the signal and detect its period, especially for the signal with low signal-noise ratio and low duty cycle.

PULSAR-BASED TIMING SYSTEM

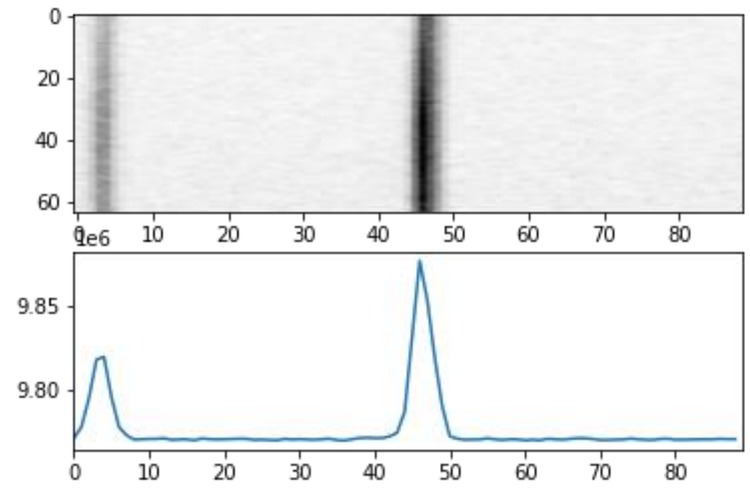




FAST FOLDING ALGORITHM



IMPLEMENTATION AND RESULTS



Pulsar profile after folding

Pulsar	Period	Data length	Data size	Time cost of brute force folding	Time cost of fast folding
B1937+21	1.5578ms	10 min	70G	47.77s	0.5s

With week pulsar signal, for example, the SNR is lower than 5 and duty cycle is lower than 5%, matched boxcar filter and wavelet transform are useful to de-noise, the SNR can be increased by 35%-65%.

CONSLUSION

- FFA is an efficient method to phase-coherently fold an evenly sampled time series at multiple closely spaced trial periods at once, taking advantage of the many redundant calculations in the process.
- For pulsar signal with high ratio noise, matched boxcar filter and wavelet transform are useful to de-noise.