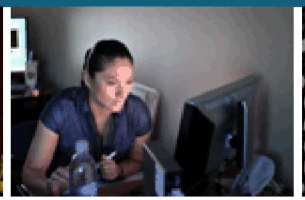
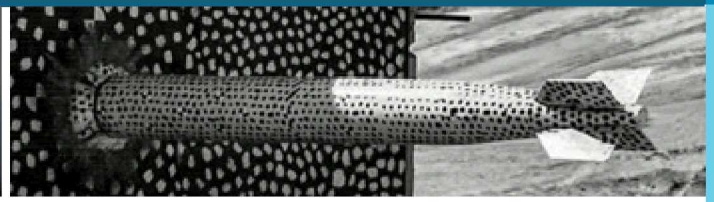
SAND2019-4259C

Robust Arrival Time Uncertainty Estimation Using Gaussian Blurring





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Our Problem and Motivation

Analysts have to make decisions on waveforms very quickly

- They have hundreds of signals to go through in a given day
- More data is coming in than is being completed

We want to give more information to the analyst to help the decision making process of when an onset detection occurs

Our Approach

Given

- We have a window of a waveform
  We know a signal arrives at some point in this window

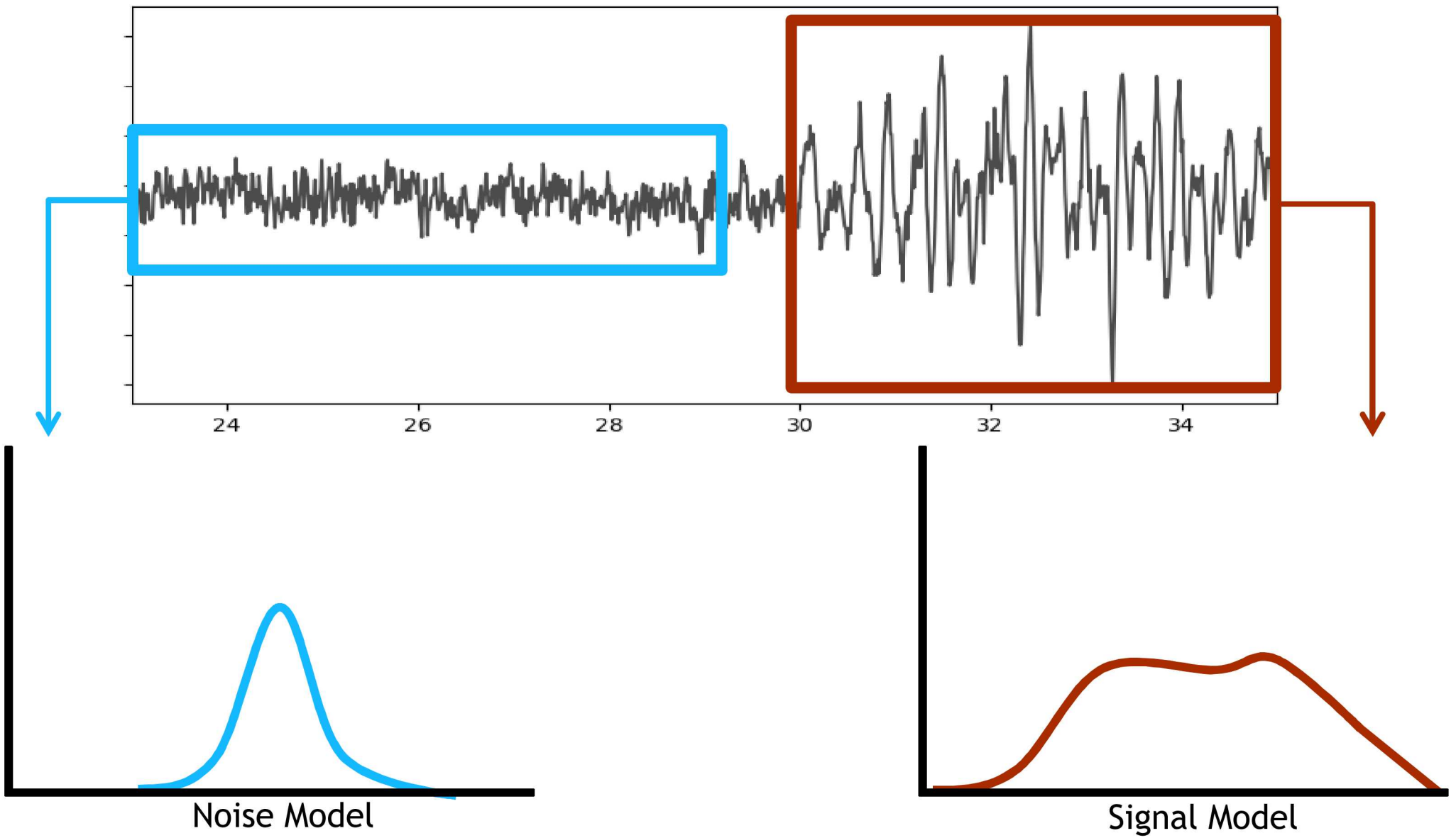
Output

- A distribution over time of the probability that an onset time occurs

What we do

- Calculate a model for the Noise and Signal
- Generate noise
- Create Bootstrap samples by adding noise to the signal
- Pick the onset time for each Bootstrap Sample
- Aggregate the Bootstrap picks into a distribution over time of where the True Onset time occurs

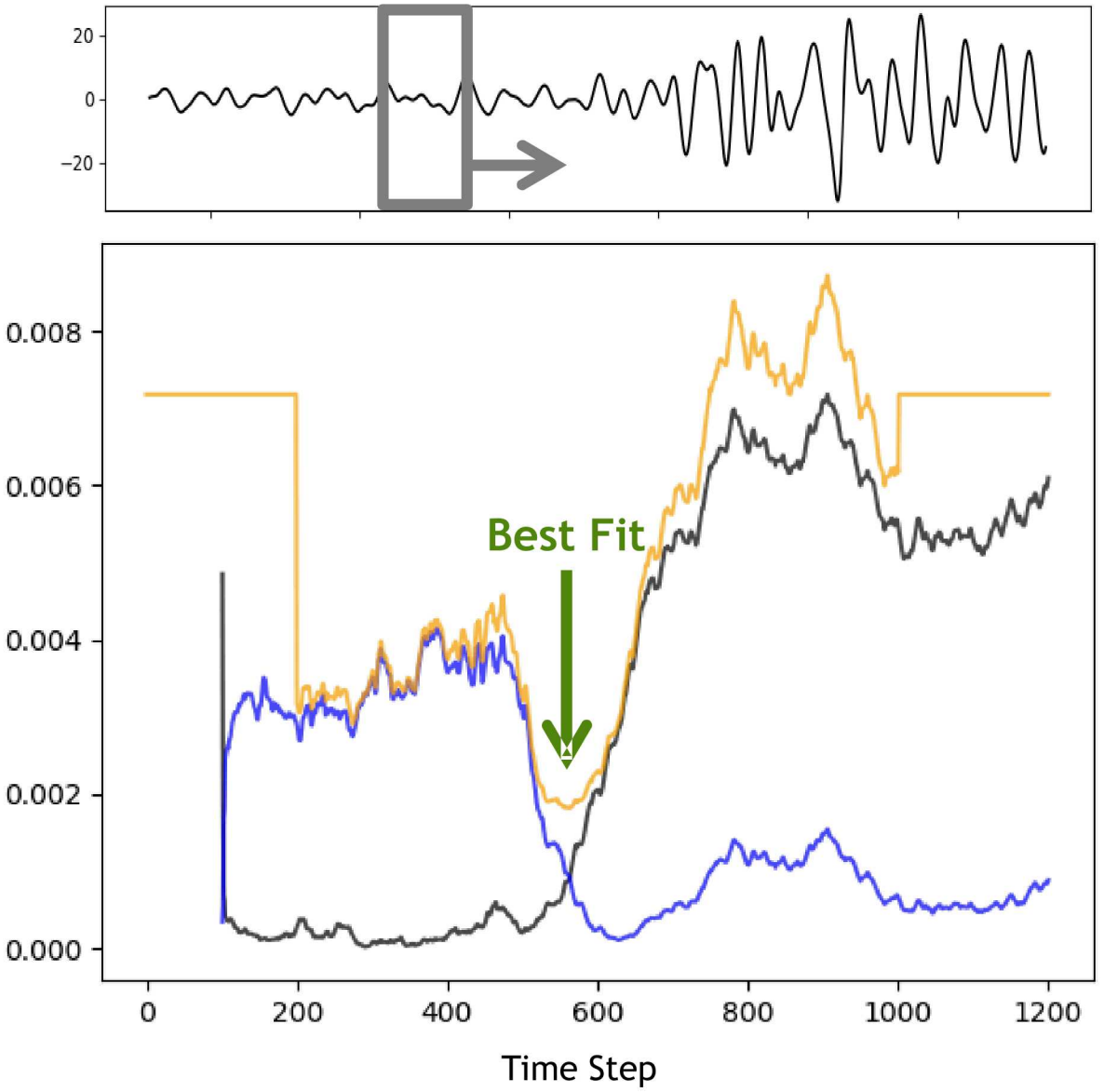
Creating our Noise and Signal Models



Finding the Onset

We calculate the fitting metrics of our Noise and Signal models across the entire search space

- **BLACK** line is the fitting of the Noise model
- **BLUE** line is the fitting of the Signal model
- **YELLOW** line is the combination of both the noise and signal fitting scores
- The lowest value is the best fit point, shown in **GREEN**



Generating Bootstrap Samples

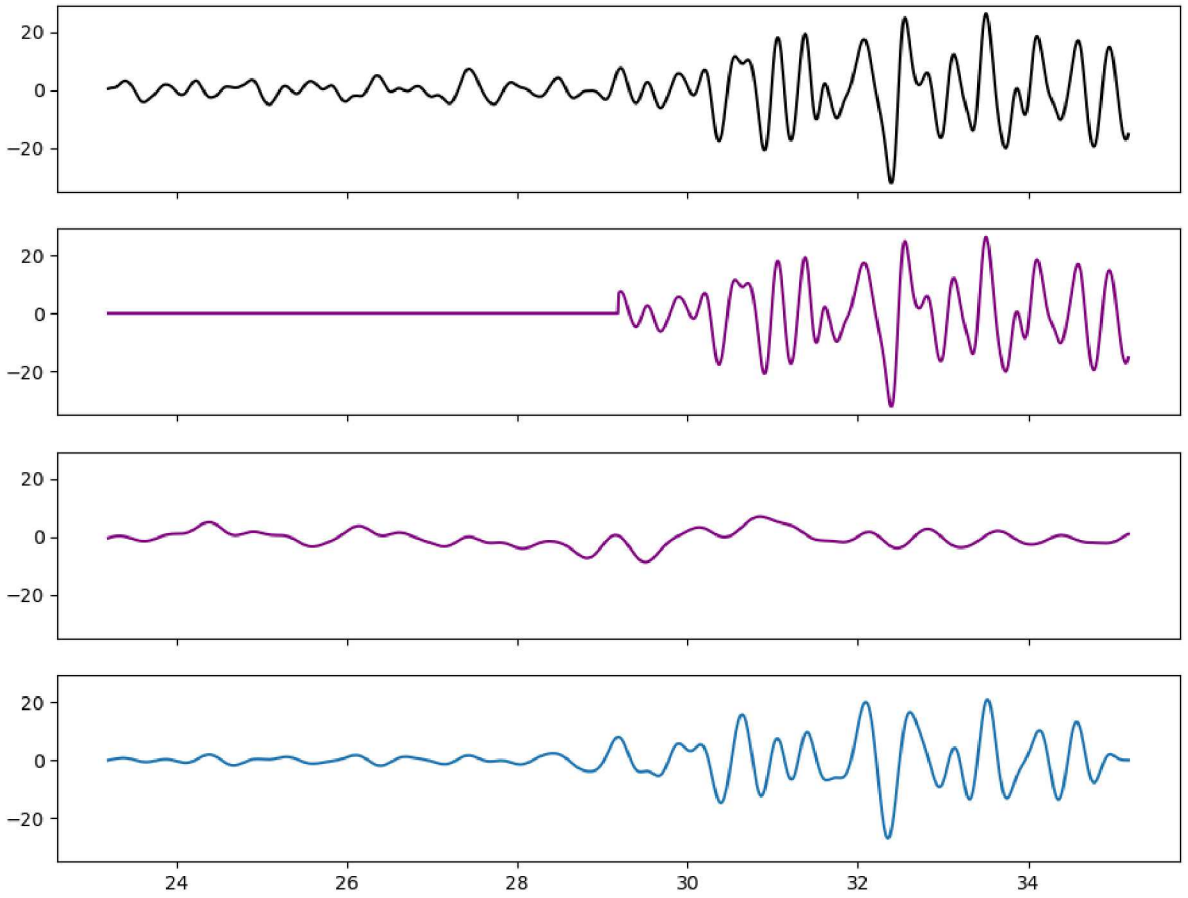
Row 1: the **BLACK** line is the original filtered waveform

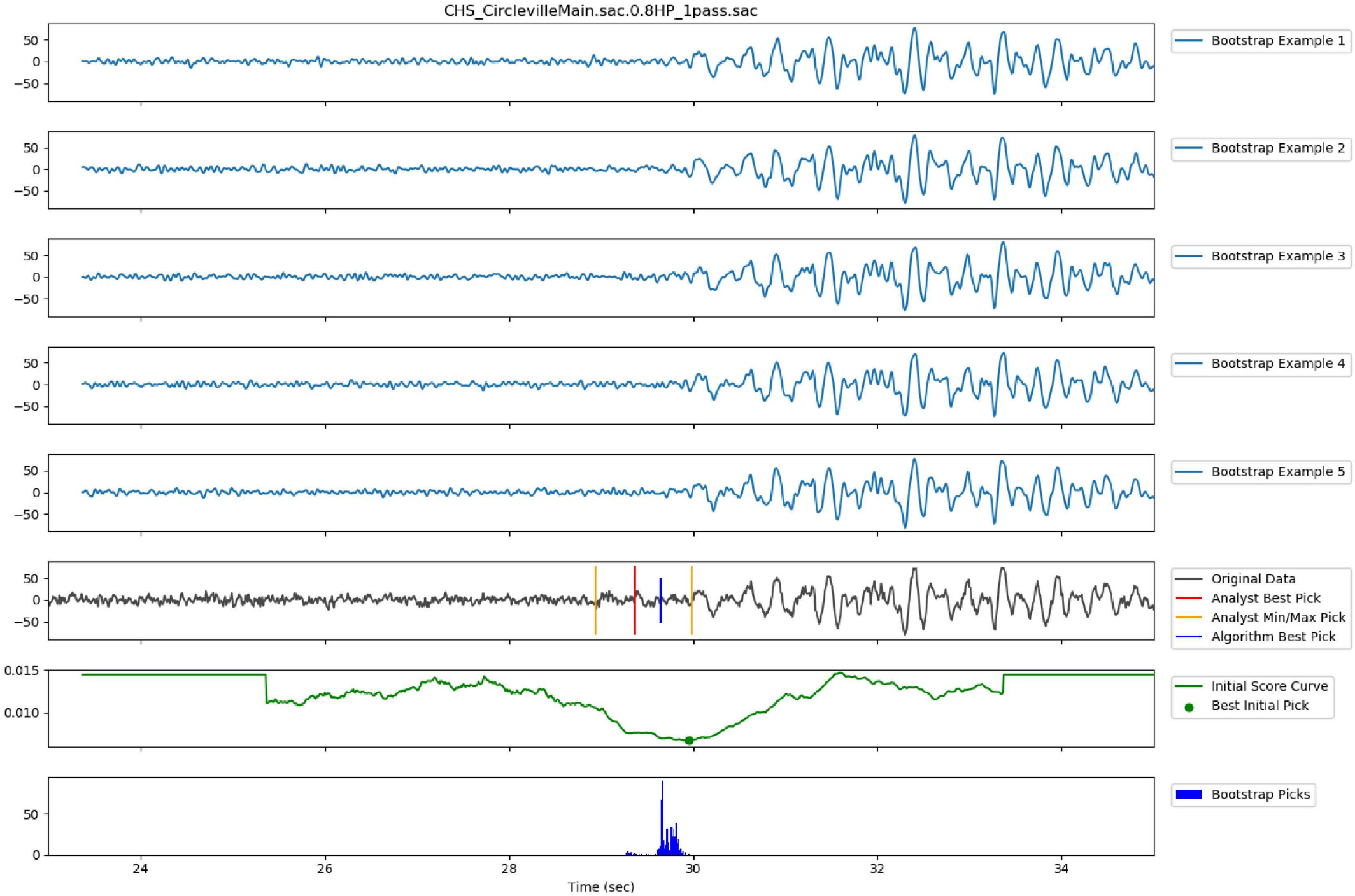
Row 2: the **PURPLE** line is the signal from the original waveform

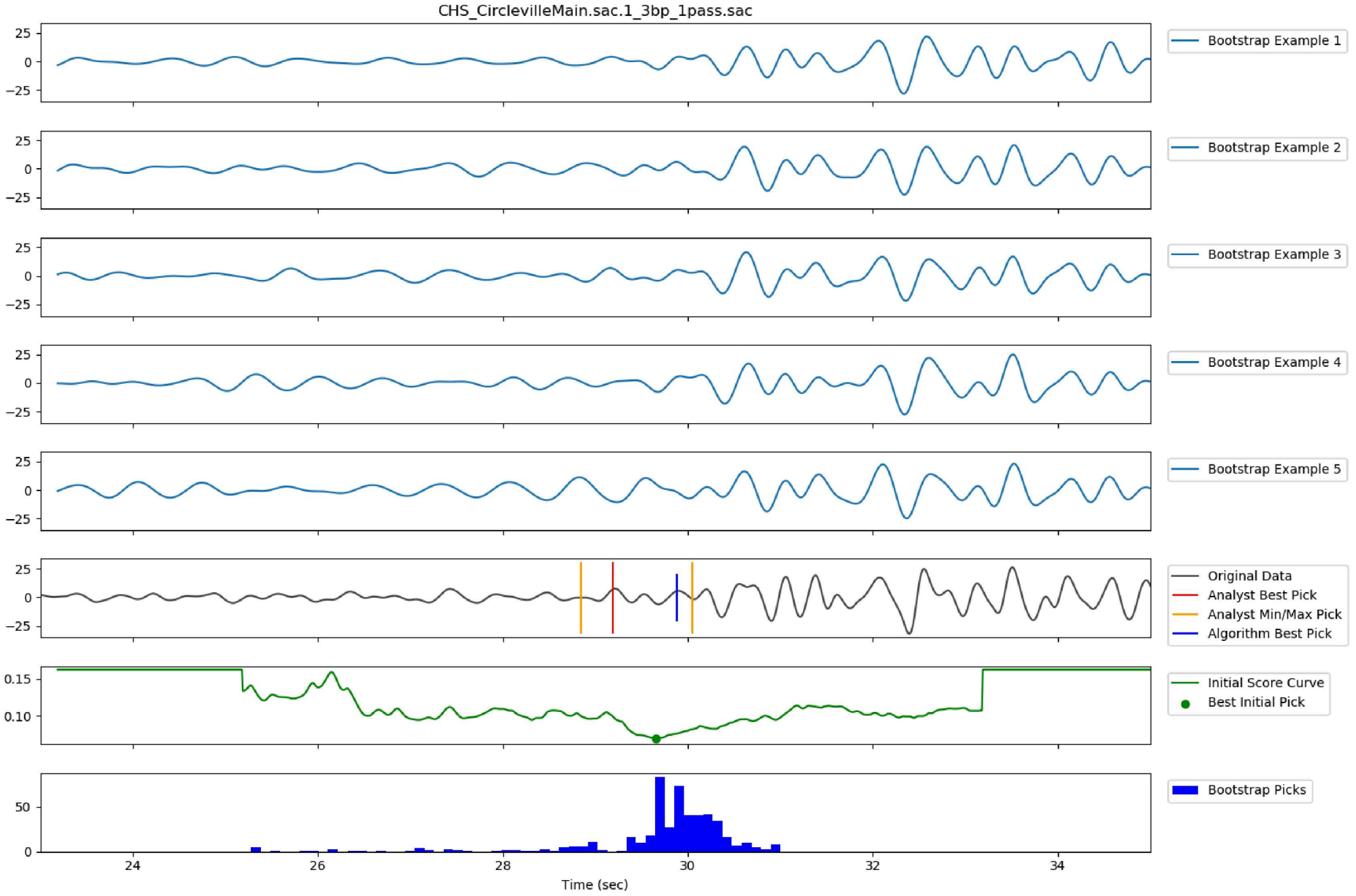
Row 3: the **PURPLE** line is the generated noise

Row 4: the **BLUE** line is the new bootstrap sample

- The summation of Rows 2 and 3




CHS_CirclevilleMain.sac.0.8HP_1pass.sac
Bootstrap Example 1
Bootstrap Example 2
Bootstrap Example 3
Bootstrap Example 4
Bootstrap Example 5
Original Data
Analyst Best Pick
Analyst Min/Max Pick
Algorithm Best Pick
Initial Score Curve
Best Initial Pick
Bootstrap Picks
Time (sec)


CHS_CirclevilleMain.sac.1_3bp_1pass.sac
Bootstrap Example 1
Bootstrap Example 2
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Bootstrap Example 5
Original Data
Analyst Best Pick
Analyst Min/Max Pick
Algorithm Best Pick
Initial Score Curve
Best Initial Pick
Bootstrap Picks
Time (sec)

Future Work

Improve our noise generation method

- Currently only taking amplitude into account
- We want to incorporate frequency

Add more features to our Noise and Signal models

- We want to track the changes in frequency as well as the amplitude changes

Remove the assumption that an onset time occurs in our search window

- We currently know that a signal arrives somewhere in our search window
- This allows us to assume the left side of the window is mostly noise and the right side is mostly signal