A Modified RFI Flagging Strategy for Transient Radio Signals

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Summary

One of the biggest issues for any radio telescope is its RFI flagging capabilities, and special consideration is needed for flagging data which may contain transient radio signals. These transient radio signals can be mistaken for RFI by automated flagging algorithms used by radio telescopes. The current default flagging strategy for LOFAR, part of AOFlagger, may not be ideal for observations containing transients because it often flags transient-like signals in an attempt to flag all the RFI in the data set. Here we present a modified flagging strategy that has been developed for transient data. These tests have been conducted on both real data sets and and test data sets where artificial transients were inserted into a Gaussian noise field, and show the potential for using this modified flagger for future LOFAR transient searches.

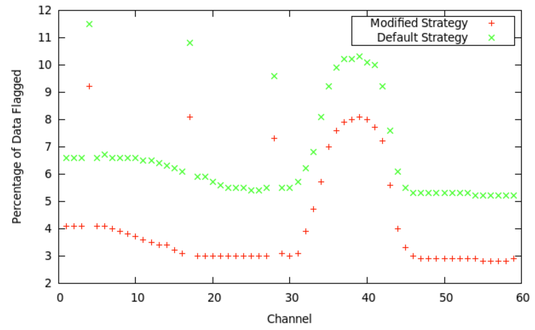
The Current Flagging Framework

- AOFlagger is the default automated flagging strategy used by LOFAR, developed by Andrè Offringa
- Works with the amplitude information of one polarization of a single sub-band, designed to catch all the RFI even if some non-contaminated data gets flagged
- It relies on thresholding, where cutoffs depend on the surrounding signal levels
- Further, time selection steps compare RMS values and automatically flag anything with a sigma > 3.5 for quick convergence
- **This may not be ideal for observations containing transient signals**

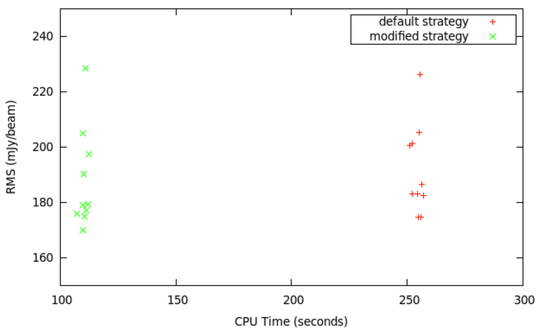
The Modified Flagger

We modified the AOFlagger to run more quickly and not flag transient signals in the data. The changes include:

- Dele time selection steps that automatically cut data which may contain transients
- Decrease “sliding window” resolution in time so sudden transient signals do not trigger the flagger
- Ignore thresholding in frequency space where cutoffs depend on surrounding signal levels



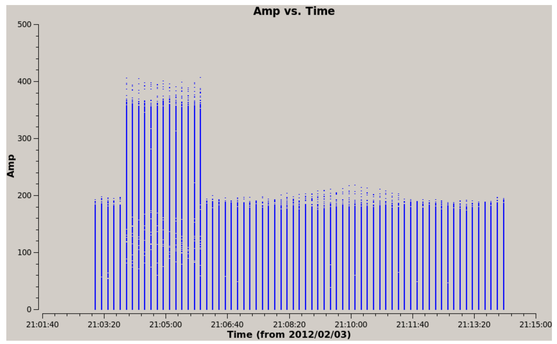
The percentage of data flagged by channel for various RFI strategies- L44766, Sub-band 151 (frequency= 73.2 MHz)



CPU vs RMS for default and modified RFI Strategies using the same data- CPU time decreases but the RMS level does not.

Simulations

We developed a script that uses a method developed by Dr. George Heald to inject Gaussian background noise into a measurement set and a technique used by Dan Calvelo to inject a point source transient signal into data where one can specify the exact location, duration, and brightness of the transient. By combining these methods one can fully control the signals in the data for various testing purposes.

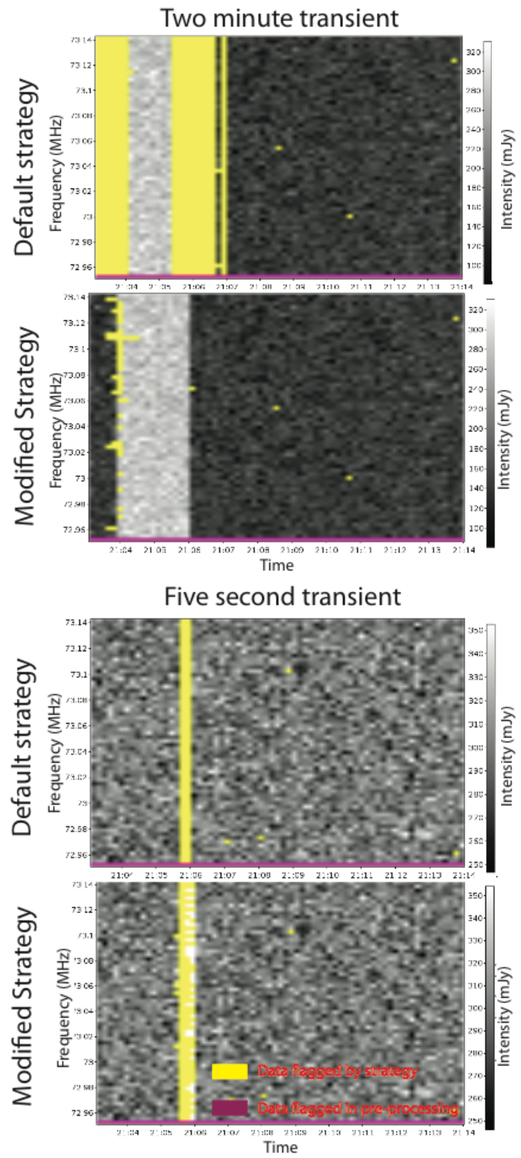


Signal strength over an 11 minute measurement set, with an inserted transient signal of 2 minute duration.

Future Work

RFI testing will continue on increasingly realistic models of simulated transient signals. Eventually, we hope to implement the modified flagging strategy in future transient searches using LOFAR, as well as use the signatures of previously flagged transients in order to retroactively detect transient signals that were mistakenly flagged in the data.

RFI Tests



RFI flagging on two baselines comparing the effectiveness of the default strategy and the modified strategy.