

National Institute of Mental Health

# New in AFNI's physio\_calc.py (for FMRI physio regressors): QC images, reports and interactive mode

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#1690

## Introduction

physio calc.py is a recent AFNI<sup>1</sup> program for processing physiological (cardiac, respiratory) time series. It creates slicewise RETROICOR<sup>2</sup> and RVT<sup>3</sup> regressors to include in FMRI processing, such as with *afni* proc.py<sup>4</sup> or other software. *New* features described here include:

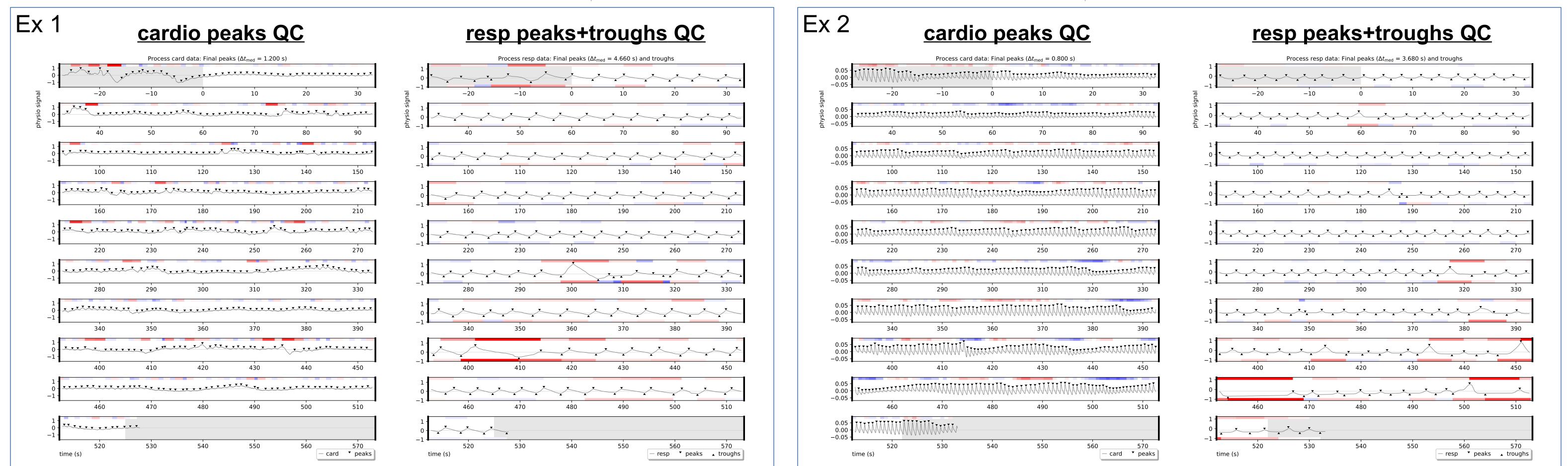
- Quality control (QC) images of physic time series processing
- A simple "interactive" mode to correct peak/trough detection
- Helpful reports of time series properties to query/compare

### Methods & Results

**Peak/trough QC:** *physio calc.py* can output several QC images of intermediate processing. In the final one, triangles highlight peaks ( $\mathbf{v}$ ) and troughs ( $\mathbf{A}$ ). Color rectangles encode each interpeak interval: median values are white, while shorter ones are bluer ( ) and longer ones are redder ( ). These can highlight either physiological patterns in the time series, or potential QC issues (e.g., an erroneous or missing peak). The same appears at the bottom of each panel when estimating troughs. The FMRI-overlap interval has a white background; the rest has a gray background (

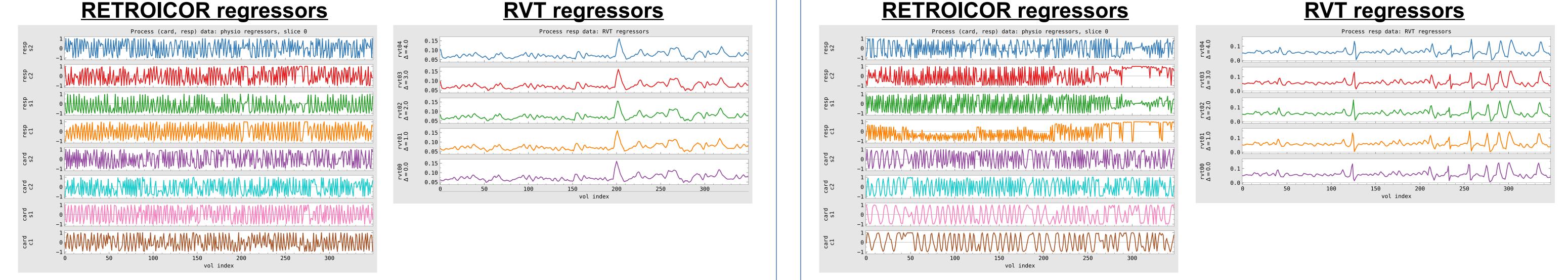
**Reports:** *physio calc.py* outputs a dictionary of useful quantities after processing each physio time series. This includes time sampling, filter information, inter-peak and trough statistics, counts of fixed points, and more. These can be combined easily using AFNI's gen ss review table.py<sup>5</sup> into an across-group spreadsheet, which can be queried to find outliers or interesting patterns. This quantitative QC is helpful in summarizing group properties and/or finding data issues.

**Interactive mode:** Users can add an option "-do\_interact" when running *physio\_calc.py*, to be able to add, remove or shift estimated peaks and troughs. This functionality requires no extra dependencies (only Matplotlib), and utilizes simple mouse- and button-clicks to edit the points. This editing can quickly improve results when processing noisy physic time series.



### <u>cardio report</u>

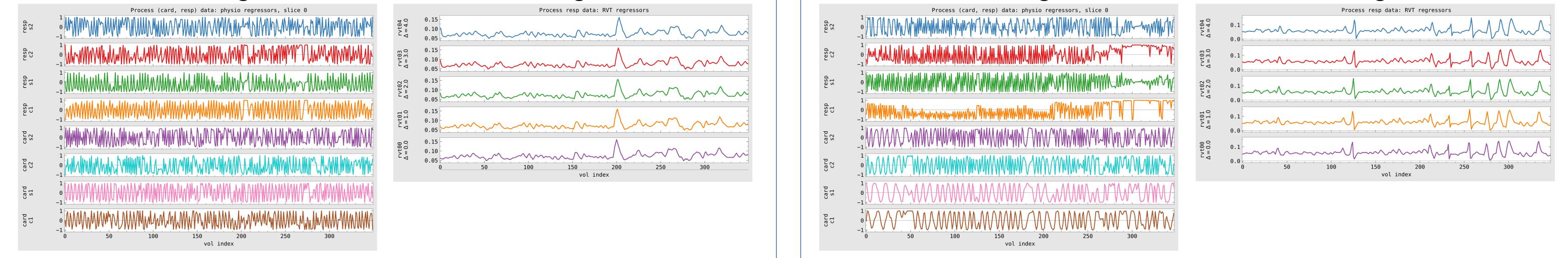
filename	: sub-08_task-wnw_run-3_physio.tsv
label	: card
read_in sampling freq	: 2000.0
prefilt mode	: median
prefilt window, sec	: 0.1
is user interact on?	: False
num peaks changed	: 0
ts_orig sampling freq	: 50.0
ts_orig sampling rate	: 0.02
ts_orig num points	: 27748
ts_orig start time	: -27.1985
ts_orig end time	: 527.761500000001
ts_orig duration	: 554.96
dset tr	: 1.500000
dset start time	: 0.000000
dset end time	: 525.000000
dset duration	: 525.000000
peak num total	: 462
peak ival min max	: 0.360000 2.720000
•	: 1.198872 0.290692
peak ival q25 q50 q75	: 1.060000 1.200000 1.280000
peak num over dset	: 441
peak ival over dset min max	: 0.360000 2.460000
peak ival over dset mean std	: 1.192227 0.279061
peak ival over dset q25 q50 q75	: 1.060000 1.200000 1.280000



#### <u>resp report</u>

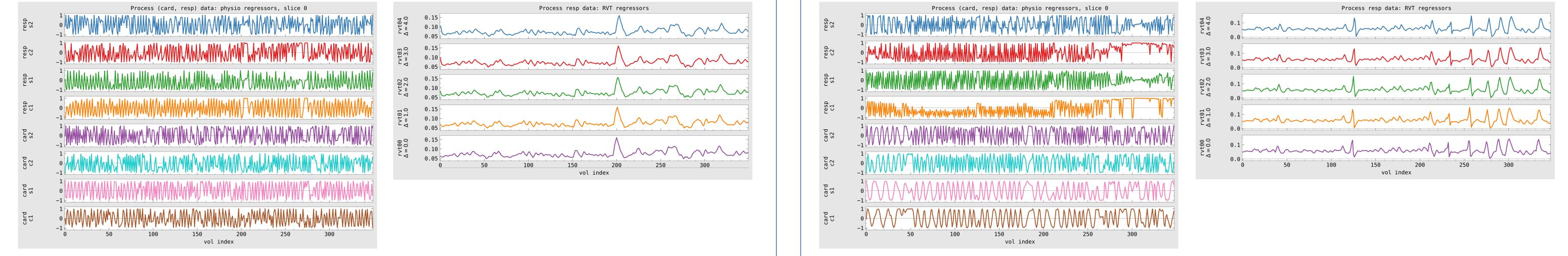
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	: 527.761500000001
ts_orig duration	: 554.96
dset tr	: 1.500000
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peak num total	: 111
peak ival min max	: 3.220000 12.700000
peak ival mean std	: 5.014727 1.310599
peak ival q25 q50 q75	: 4.345000 4.680000 5.210000
1	: 107
1	: 3.220000 12.700000
peak ival over dset mean std	: 4.946604 1.250982





#### <u>cardio report</u>

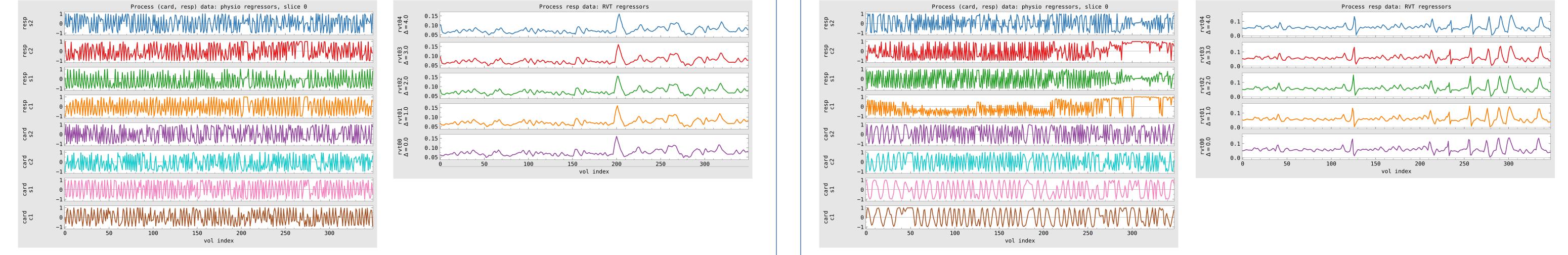
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filename	: sub-03_task-wnw_run-1_physio.tsv
label	: card
read_in sampling freq	: 2000.0
prefilt mode	: median
prefilt window, sec	: 0.1
	: False
num peaks changed	: 0
ts_orig sampling freq	: 50.0
ts_orig sampling rate	: 0.02
ts_orig num points	: 28023
ts_orig start time	: -27.392
	: 533.068
ts_orig duration	: 560.46
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dset tr	: 1.500000
dset start time	: 0.000000
dset end time	: 522.000000
dset duration	: 522.000000
peak num total	: 703
peak ival min max	: 0.660000 0.920000
	: 0.796809 0.043547
peak ival q25 q50 q75	: 0.780000 0.800000 0.820000
peak num over dset	: 657
	: 0.660000 0.920000
peak ival over dset mean std	
peak ival over dset q25 q50 q75	: 0.780000 0.800000 0.820000
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#### resp report

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### Conclusions

Physio time series can be useful for FMRI processing, but they are highly susceptible to noise and distortion and must be checked for accuracy. To date, little formal attention has been paid to the QC of these physio inputs and their computed regressors. AFNI's *physio\_calc.py* contains several features to provide efficient QC images and quantitative reporting. It also has a simple interface for fixing any features within the estimates. Careful QC of all processing steps (both visual and quantitative) is key to all FMRI processing and sub-step processing<sup>5</sup>, so these features should be considered vital in all analyses.  $\rightarrow$  And see also OHBM Poster #1687 for more discussion of physio calc.py

### Acknowledgments, References & QR Code

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