

FITACF3.0 pre-release

We include FITACF3 in RST4.1 as an optional package with FITACF2.5 remaining the default option. While the package seems to be doing a good job, this preliminary release will allow for further testing by a larger number of users just in case that some bugs/errors escaped our attention.

The package has been re-written from the scratch. In contrast to FITACF1 and 2 which effectively over-filter the data, FITACF3 uses optimal least-square fitting procedures and physically and statistically justified data selection criteria. For most of the sites FITACF3 generates a significantly larger amount of reliable data which are accompanied by realistic error estimates.

Difference with FITACF1-2:

- ***Data pre-selection***
 - Background noise estimate:
 - still based on the ten lowest lag 0 power values but corrected for the effective number of actual noise samples (1-2 dB increase compared to FITACF2)
 - “Bad” lag determination:
 - no lags are rejected based on their “bad shape” or cross-range interference level
 - only Tx-overlap lags are removed from both power and phase
 - low-power “tail” is removed from power only
- ***Fitting***
 - textbook least-square method
 - weighting coefficients:
 - these are inversely proportional to the square of the statistical fluctuation level so that the contribution from the lags with high fluctuation level to the fitting results is proportionally lower
 - now weights account for cross-range interference from all interfering ranges (previously the lags with high CRI levels were simply rejected based on an arbitrary criterion)
 - two separate sets for phase and power (these are very different because phase and power are statistically independent)
 - phase fitting includes all available lags except those affected by Tx-overlap
 - no power fits are performed on XCFs (these were never used in practice, but one can get them with FITACF2 if necessary)
- ***Echo parameter determination***
 - main parameters (velocity, SNR, spectral width) are determined in the same way as before
 - error estimates
 - calculated using textbook formulas for the least-square method
 - now include CRI effects
 - they are realistic (tested against statistical simulations)
 - Elevation:

- calculated based on lag 0 phase from ACF itself which provides more stable estimates as compared to those from fitting
- for comparison, fitted values are also provided in *fit.elv_high*
- a single least-square error is stored in *fit.elv_low*
- no XCF power, width and velocity values are recorded in the *fit* structure.

Known issues:

These are generally related to the more relaxed selection criteria. The noise determination is based on an assumption about its Gaussian distribution, which works fine for most of the sites most of the time.

1. An excessive amount of noise is observed at HOK (continuously), SAN and TIG (intermittently). These problems seem to be site-specific.
2. Sporadic “streaks” of some sort of interference are also observed at different locations. These might be related to powerful lightning strikes. We know their morphology and now work on the filtering procedure which we plan to introduce in the next release of RST.

Plans for the next release

1. Make FITACF3 the default fitting option in the next release of RST (4.2) after fixing the above-mentioned “streak” issue.
2. Include in FITACF3 the generalised algorithm for elevation calculation allowing for the arrays’ separation in all three dimensions (Shepherd, 2017).