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Real-time e-VLBI in the EVN and software correlation at JIVE

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Real-time e-VLBI continues to form an integral element of the European VLBI Network (EVN), accounting for about a quarter of all EVN hours and providing unique rapid-response capabilities to transient events as well as the opportunity for higher-cadence observations compared to the standard EVN sessions that fall three times per year. The EVN software correlator at JIVE (SFXC) can currently process real-time correlation for a 14-station array at 1 Gbps with cross-polarizations. Tests show that 8-9 stations at 2 Gbps can also be sustained.

The classes of e-EVN proposals has grown to include two new types of triggered observations. "Generic triggers" allow a set of potential targets that can not be defined explicitly at proposal time, which opens e-EVN observations to newly discovered transient sources. "Automatic triggers" can receive and adjudicate trigger requests without human intervention (e.g., by a program listening for specified VO events), and can similarly create and distribute an appropriately modified schedule to override the currently running observations (for stations permitting such remote interventions). This can provide significantly faster response – down to 10 minutes, as compared to the 29 hr for traditional triggers. Running jive5ab at the correlator and the stations enables simultaneous real-time e-VLBI correlation and recording (at the correlator and/or at the stations). This permits, among other applications, commensal searches for transients via analysis of the real-time auto-correlations, the result of which could trigger a wide-field correlation of the baselines for the corresponding time-range, detached from the on-going real-time correlation.

SFXC has processed all EVN disk-based observations correlated at JIVE since the May/June 2012 session, and all e-EVN observations since December 2012. It removes the physical limitations to the number of stations, the channel & total bit-rates, and the number of frequency points. It also applies a purely station-based fringe rotation, decouples the correlation and delay-tracking FFT sizes, and permits choice of the spectral-windowing function. It can correlate observations containing a mixed number of channels, mixed channel bandwidths, and mis-matched side-bands – accelerating developments in various digital back-ends has led to this being a quite routine situation. SFXC opens up new astronomical areas for correlation at JIVE via pulsar gating/binning (including coherent de-dispersion), multiple phase-center output within a wider field, spectral zooming, space VLBI (comprising both antennas in orbit such as RadioAstron, and near-field targets in the solar-system), and a phased-up mode. Each of these has been exploited by proposal-driven user experiments over the past couple years.

Primary author: Dr CAMPBELL, Bob (JIVE)

Co-authors: Dr KEIMPEMA, Aard (JIVE); Dr SZOMORU, Arpad (JIVE)

Presenter: Dr CAMPBELL, Bob (JIVE)

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