realfast: Real-time, Commensal Fast Transient Surveys with the Very Large Array

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Radio interferometers have the ability to precisely localize and better characterize the properties of sources. This ability is having a powerful impact on the study of fast radio transients, where a few milliseconds of data is enough to pinpoint a source at cosmological distances. However, recording interferometric data at millisecond cadence produces a terabyte-per-hour data stream that strains networks, computing systems, and archives. Here, we present *realfast*, a commensal, fast transient search system at the Jansky Very Large Array. *Realfast* uses a novel architecture to distribute fast-sampled interferometric data to a 32-node, 64-GPU cluster for real-time imaging and transient detection. By detecting transients *in situ*, we can trigger the recording of data for those rare, brief instants when the event occurs and reduce the recorded data volume by a factor of 1000. This makes it possible to commensally search a data stream that would otherwise be impossible to record. This system will search for millisecond transients in more than 1000 hours of data per year, potentially localizing several Fast Radio Bursts, pulsars, and other sources of impulsive radio emission.