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GPS Signal Acquisition via Compressive Multichannel Sampling

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In this paper, we propose an efficient acquisition scheme for GPS receivers. It is shown that GPS signals can be effectively sampled and detected using a bank of randomized correlators with much fewer chip-matched filters than those used in existing GPS signal acquisition algorithms. The latter use correlations with all possible shifted replicas of the satellite-specific C/A code and an exhaustive search for peaking signals over the delay-Doppler space. Our scheme is based on the recently proposed analog compressed sensing framework, and consists of a multichannel sampling structure with far fewer correlators.

The compressive multichannel sampler outputs are linear combinations of a vector whose support tends to be sparse; by detecting its support one can identify the strongest satellite signals in the field of view and pinpoint the correct code-phase and Doppler shifts for finer resolution during tracking. The analysis in this paper demonstrates that GPS signals can be detected and acquired via the proposed structure at a lower cost in terms of number of correlations that need to be computed in the coarse acquisition phase, which in current GPS technology scales like the product of the number of all possible delays and Doppler shifts. In contrast, the required number of correlators in our compressive multichannel scheme scales as the number of satellites in the field of view of the device times the logarithm of number of delay-Doppler bins explored, as is typical for compressed sensing methods.

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