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Efficient Replica Generation for Space Time Adaptive Processing of Acoustic Signals

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This paper addresses an innovative method for real-time replica generation using generalized Green's function for Space Time Adaptive Processing (STAP) technology for sonar applications. In hypothesis processing for STAP algorithms, the first step is to generate replicas for various target hypothesis such as the infinite-range fixed-direction (IRFD) target hypotheses or the tracking (trajectory) hypotheses. Once generated, these replicas are used in multiple steps of the STAP algorithm for computing system parameters such as the signal to noise ratio. Replicas are traditionally pre-computed or hard-wired due to computational load constraints. Such a pre-computation precludes direct application of array shape corrections, and limits the ability to process arbitrary target trajectories. W propose to use a generalized Green's function for efficient and ultra-fast real-time generation of replicas on multi-core processors Specifically, for an arbitrary target trajectory $r_T(t_i)$=[$x_T(t_i)$, $y_T(t_i)$, $z_T(t_i)$], arbitrary receive array trajectory $r_{R(k)}(t_i)$=[$x_{R(k)}(t_i)$, $y_{R(k)}(t_i)$, $z_{R(k)}(t_i)$], (k=1,...,N_{EL}), arbitrary vector of frequencies in homogeneous acoustic medium f=[f_1,f_2,....,f_n,...], and sound speed c_0, we can write $G[r_T(t_i),r_{R(k)}(t_i),f_n|c_0]$= exp[$j(2\pi f_n/c_0)|\ r_{R(k)}(t_i)$- $r_T(t_i)\ |]/\ |\ r_{R(k)}(t_i)$- $r_T(t_i)\ |$ In terms of rationale, this is the simplest possible replica set for any STAP algorithm. The efficient implementation of the generalized Green's function on a multi-core processor will allow real-time adjustment/modification of acoustical target tracking resulting in improved numerical accuracy and time performance.