Projective stochastic equations and nonlinear long memory

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A projective moving average $\{X_t, t \in \mathbb{Z}\}$ is a Bernoulli shift written as a backward martingale transform of the innovation sequence. We introduce a new class of nonlinear stochastic equations for projective moving averages, termed projective equations, involving a (nonlinear) kernel Q and a linear combination of projections of X_t on "intermediate" lagged innovation subspaces with given coefficients $\alpha_i, \beta_{i,j}$. The class of such equations include usual moving-average processes and the Volterra series of the LARCH model. Solvability of projective equations is obtained using a recursive equality for projections of the solution X_t. Under certain conditions on $Q, \alpha_i, \beta_{i,j}$, this solution exhibits covariance and distributional long memory, with fractional Brownian motion as the limit of the corresponding partial sums process.