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DYNAMIC FACTOR MODELING VIA ROBUST SUBSPACE TRACKING.

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Statistical factor models have been widely used in finance to reduce the dimensionality of the investment universe for modeling both risk and return. In fixed income, thethree-factor principal component analysis (PCA) model has an intuitive interpretation oflevel-shift, slope and curvature changes of an interest rate, or bond yield curve. Forequities, using PCA allows to reduce the dimensionality from several thousands US stocksto about 30-50 factors. To construct the factors reliably, typically one or more yearsof historical daily prices are used. While this produces stable factors decomposition,such a model can not quickly react to changes in the market. Using shorter windows,or faster decay in exponential smoothing does follow market evolution but produces veryerratically changing factors, highly sensitive to short-lived spikes in volatility, andother market anomalies.

We formulate bond yield curve estimation as a nonlinear Kalman smoothing problem, where the state is a low dimensional (subspace) representation of the curve. This allows us to attack the problem using recently developed optimization techniques for nonlinear Kalman smoothing. In particular, robust Kalman smoothing formulationsand algorithms can estimate principal componentsso that theyreact to market changes while being consistent with historical estimates and ignoringshort-lived anomalies. We propose a matrix free optimization technique that takes advantage of the special structure of the problem to make the approach efficient for the subspace tracking application.

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