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Fast hybrid schemes for fractional Riccati equations (rough but not so tough)

Abstract : We solve a family of fractional Riccati equations with constant (possibly complex) coefficients. These equations arise, for example, in fractional Heston stochastic volatility models, which have received great attention in the recent financial literature because of their ability to reproduce a rough volatility behavior. We first consider the case of a zero initial value corresponding to the characteristic function of the log-price. Then we investigate the case of a general starting value associated to a transform also involving the volatility process. The solution to the fractional Riccati equation takes the form of power series, whose convergence domain is typically finite. This naturally suggests a hybrid numerical algorithm to explicitly obtain the solution also beyond the convergence domain of the power series. Numerical tests show that the hybrid algorithm is extremely fast and stable. When applied to option pricing, our method largely outperforms the only available alternative, based on the Adams method.