Krylov subspace methods for matrix equations which include matrix functions

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We consider the numerical solution of large-scale Lyapunov equations of the form

$$AX + XA^T + f(A)BB^T + BB^T f(A) = 0, \quad A \in \mathbb{R}^{n\times n},\ B \in \mathbb{R}^{n\times m},$$

where f is an analytic function of A. Such matrix equations arise in certain model order reduction methods. Our focus are projection type approaches which employ rational or extended Krylov subspaces. For dealing with the above problem we propose efficient methods that deal with both the Lyapunov equation and the matrix function $f(A)$ at the same time.