Comparative cost and preferred method

Both correct spectral methods require centring. A covariance construction costs $O(mN^2)$ arithmetic and $O(N^2)$ storage; a thin SVD can work directly with Z, at $O(mN\min(m,N))$ classical dense cost. When $m \ll N$, the $m \times m$ Gram formulation reduces the eigensystem dimension. The proof certifies the global optimum; it does not establish a runtime advantage over an already appropriate thin-SVD implementation.