We propose a comparison of algorithms that use time-domain data to fit models of dynamical systems that explain the available measurements. The eigensystem realization algorithm (ERA) and the Loewner framework (LF) constitute data-driven methods for identifying and reducing linear and nonlinear dynamical systems. The ERA uses the system’s invariants known as Markov parameters into a matrix of Hankel structure. Similarly, the LF encodes the invariants of a system into the Loewner matrix structure through frequency-domain measurements. These can be estimated from time-domain data by employing spectral transforms. For both methods under consideration, the singular value decomposition (SVD) provides a trade-off between the complexity and the accuracy of the reduced model. These two approaches are compared first for the case of fitting linear systems and then, for fitting systems with nonlinear dynamics, such as bilinear systems. We discuss recent extensions for the latter case.