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A modified Gauss-Jackson method for the numerical integration of the variational equations.

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We introduce a modified Gauss-Jackson method for the integration of satellite state as well as the state transition and sensitivity matrices. It is discussed for a long time that the correction step in the Adams-Bashforth-Moulton and the Stoermer and Cowell methods might not be necessary in certain conditions. We investigate this issue and show that for low Earth orbiting satellites such as GRACE and future GRACE FO, the correction step can be discarded since the prediction step provides sufficient accuracy. We make use of this fact and derive a closed-form one-step Gauss-Jackson method which performs very fast and efficient, not only for the integration of the satellite's state but also for the integration of the state transition matrix as well as the sensitivity matrix. We derive the tabular coefficients of the modified integration technique as well as the matrix of backward differences. The performance of this integration technique is discussed and demonstrated in the context of orbit adjustment and gravity field recovery from GRACE observations.