Determination of Acceleration from 3D Reconstruction of Coronal Mass Ejections Observed by STEREO

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We employ a three-dimensional (3D) reconstruction technique, for the first time to study the kinematics of six coronal mass ejections (CMEs), using images obtained from the COR1 and COR2 coronagraphs on board the twin STEREO spacecraft, as also the eruptive prominences (EPs) associated with three of them using images from the Extreme UltraViolet Imager (EUVI). A feature in the EPs and leading edges (LEs) of all the CMEs was identified and tracked in images from the two spacecraft, and a stereoscopic reconstruction technique was used to determine the 3D coordinates of these features. True velocity and acceleration were determined from the temporal evolution of the true height of the CME features. Our study of kinematics of the CMEs in 3D reveals that the CME leading edge undergoes maximum acceleration typically below 2R$_\{odot}$. The acceleration profiles of CMEs associated with flares and prominences exhibit different behaviour. While the CMEs not associated with prominences show a bimodal acceleration profile, those associated with prominences do not. Two of the three associated prominences in the study show a high and rising value of acceleration up to a distance of almost 4R$_\{odot}$ but acceleration of the corresponding CME LE does not show the same behaviour, suggesting that the two may not be always driven by the same mechanism. One of the CMEs, although associated with a C-class flare showed unusually high acceleration of over 1500 m s^{-2}. Our results therefore suggest that only the flare-associated CMEs undergo residual acceleration, which indicates that the flux injection theoretical model holds good for the flare-associated CMEs, but a different mechanism should be considered for EP-associated CMEs.

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