

Study on Actual Accident Reconstruction Using Combined Event Data Recorder Data and Drive Recorder Video with High-Precision Estimation Results of Vehicle Trajectory

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Accurate reconstruction of the pre-crash vehicle behavior and its position relative to the road structures is important for investigating the causes of traffic accidents. In a previous report (1), the authors reconstructed the vehicle behavior, the driver operation and the forward view in a single time series from event data recorder (EDR) data and drive recorder (DR) video. There, the trajectory obtained by integrating the vehicle speed and yaw rate recorded by the EDR, hereafter the EDR trajectory, was placed on the road map by eye, so that the judgment of the analyst was involved.

In the preceding report (2), an image sequence from the DR video and three-dimensional point cloud data measured at the accident site by 3D-LiDAR were input to the COLMAP-PCD algorithm to estimate, for every frame, the position and attitude of the camera, which is fixed to the vehicle; this gives the DR trajectory. Because the point cloud records the road and its structures at true scale, every frame is located on the road map and the DR trajectory is fixed on it. This study applies the preceding method to an actual accident and places the EDR trajectory with the DR trajectory as the reference.

Fig. 1 shows the procedure. Steps 1 and 2 give the DR trajectory and the EDR trajectory, on which each position corresponds to one image frame and to one EDR recording time, respectively. Step 3 aligns the collision frame of the DR video with the EDR trigger time of 0 s, so that an image frame is determined for every position on the EDR trajectory. Step 4 overlays the two trajectories at the positions sharing the same image frame; as the relative positions along the EDR trajectory are already fixed, only its position and orientation as a whole remain, and two correspondences are sufficient.

The accident analyzed was a single-vehicle accident with multiple collisions at a T-junction with a stop line: the driver depressed the accelerator pedal instead of the brake pedal, accelerated across the intersecting road and struck a curb (primary collision), a step (secondary) and a pole (tertiary), at which the EDR was triggered. Eleven positions ① to ⑪ were obtained on the EDR trajectory, and the DR trajectory was obtained from ① to ⑥ but not for ⑦ and ⑧; the six correspondences determined the placement, from which the positions of ⑦ and ⑧ also followed.

Fig. 2 shows the reconstruction. The distance from ⑨, at which the longitudinal acceleration turns to deceleration, to the curb was approximately 1.7 m, equal to the measured distance from the airbag control module, the vehicle reference point, to the vehicle front end. The primary collision is therefore considered to have occurred at ⑨, whereas the EDR data alone locate it only between ⑧ and ⑨. The recorded data can also be related to the road environment: the accelerator pedal opening was 46 % at ⑤, approximately 7.5 m before the stop line, and 98.5 % at ⑥, approximately 1 m beyond it. The section to which the method applies depends on the condition of the DR video.

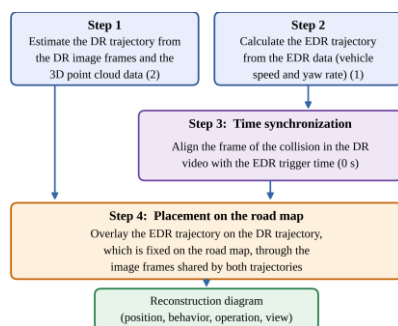


Fig. 1 Procedure for placing the EDR trajectory on the road map

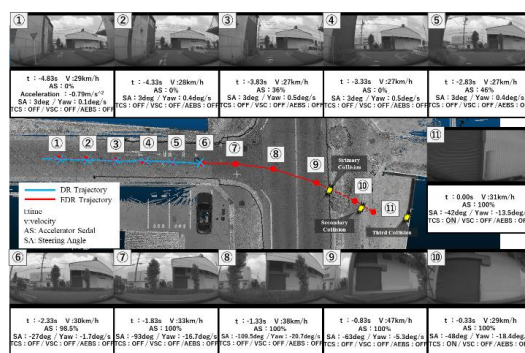


Fig. 2 Reconstruction diagram with the EDR trajectory, DR images and EDR data

(1) H. Matsumura, M. Sugiyama, and T. Iwata: Study on a method for reconstructing pre-crash situations using data of an event data recorder and a dashboard camera, SAE Technical Paper 2024-01-2891, 2024, doi:10.4271/2024-01-2891.

(2) H. Matsumura, K. Tainaka, M. Sugiyama, K. Ishizuka, et al.: Study on a high-precision estimation method of a driving trajectory using drive recorder video and 3D-LiDAR data, Proceedings of the JSAE 2026 Annual Congress (Autumn), 2026.