NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C. 20594

January 27, 2016

Video Study

NTSB Case Number:
CEN15FA034

A. ACCIDENT

Location:	Wichita, Kansas
Date:	October 30, 2014
Time:	0949 CST
Airplane:	Raytheon King Air B200

B. AUTHOR

Dan T. Horak
NTSB

C. ACCIDENT SUMMARY

On October 30, 2014, about 0949 central standard time, a Raytheon Aircraft Company King Air B200, N52SZ, operated by a private individual, was destroyed shortly after takeoff when it impacted a building at the Wichita Mid-Continent Airport (KICT). The private pilot sustained fatal injuries. Visual meteorological conditions prevailed for the personal flight conducted under Title 14 Code of Federal Regulations Part 91. The flight originated from KICT and was destined for Mena Intermountain Municipal Airport (KMEZ), Mena, AR.

The airplane was taking off from Runway 1R. Shortly after takeoff, the pilot reported that power was lost in the left engine. The airplane was powered by two Pratt & Whitney PT-6 turboprop engines. Witnesses reported that the airplane started turning left and banking sharply to the left. The airplane descended rapidly and hit the east wall and roof of the Cessna Citation Learning Center, operated by Flight Safety International, Inc. The impact and post-crash fire resulted in three additional fatalities inside a flight simulator in the building. Four flight simulators in the north end of the building were substantially damaged.

D. <u>DETAILS OF INVESTIGATION</u>

The goal of this study was to estimate the trajectory and speed of the accident airplane based on information extracted from video recordings. Three cameras captured the accident airplane in flight. One camera was on a Rockwell Collins building ('Rockwell' camera). Two cameras were on a Signature Flight Services building ('Side Drive' camera and 'Parking Lot' camera). The Rockwell camera captured the airplane for approximately five seconds when it was already malfunctioning and turning left. The Parking Lot camera captured less than two seconds of flight, just before the airplane impacted the Cessna Citation Learning Center building. The Side Drive camera captured less than one second near the middle of the Parking Lot segment.

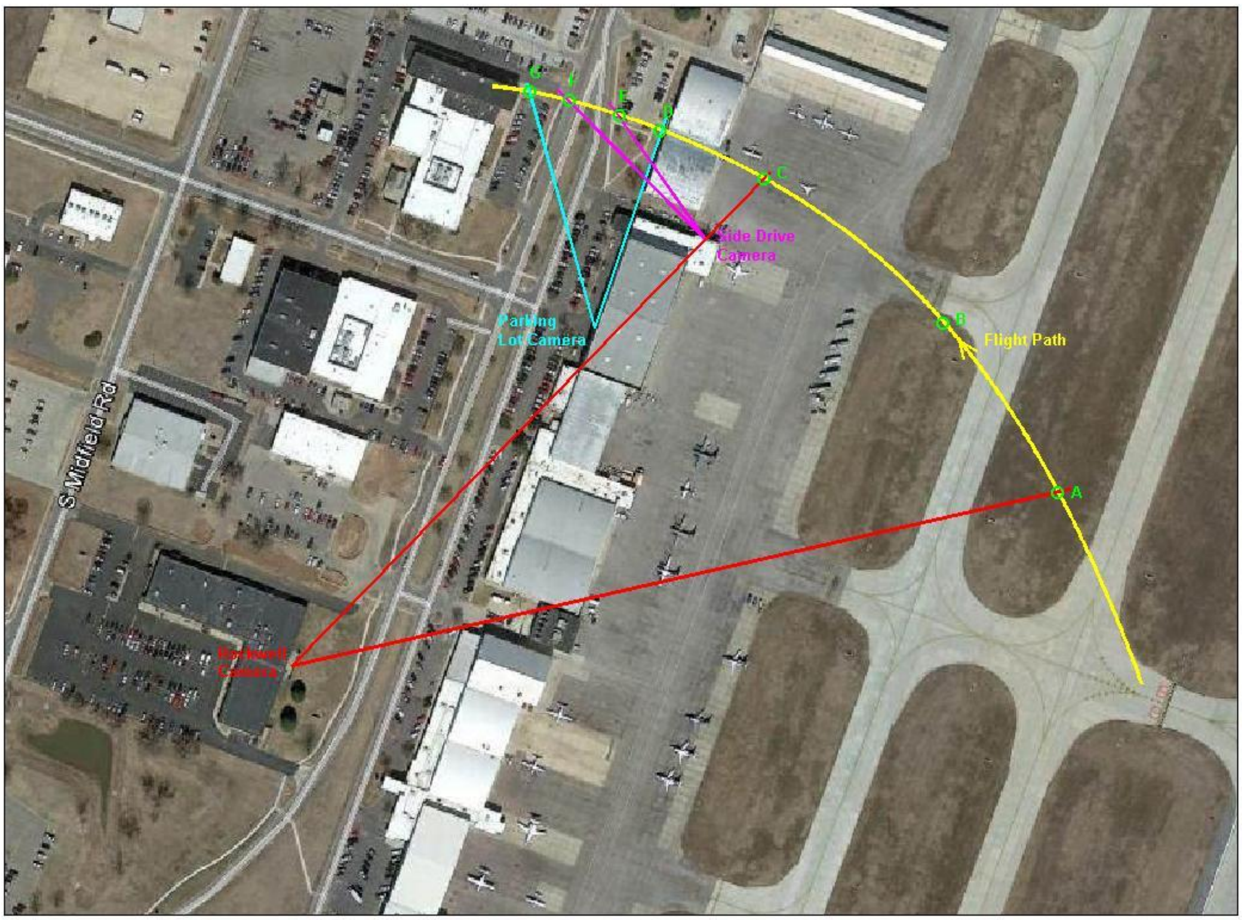

Figure 1 Camera Locations and Analysis Segments

Figure 1 is a Google Earth view of the accident area. It shows the locations of the three cameras and the angular segments in which the airplane was visible from each camera. These segments are less than the optical horizontal fields of view of the cameras. The Rockwell camera segment was restricted on the left side by poor visibility. While the airplane was still in the field of view of the camera, it was not visible in the video. The distance of the airplane from this camera was over 1200 ft and the camera resolution was relatively low. The segment of the Side Drive camera was restricted on the right side by the vertical field of view of the camera and on the left side by a tree. The segment of the Parking Lot camera was restricted on the right side by a building and on the left side by poor visibility.

The Rockwell video had frame rate of 15 fps. Frames from the other two cameras were available at frame rate of 4 fps.

The analysis was performed in three stages. First, each camera was calibrated to allow development of a model of its optics. Then the three calibrated camera models were used for estimating the location of the airplane at times corresponding to video frames. Finally, the estimates based on the three videos were merged to generate one continuous trajectory estimate from the time the airplane first appeared in the Rockwell camera video till the time when it was no longer visible in the Parking Lot camera video. The total time over which analysis was possible was approximately 8.3 seconds. The three analysis stages are described next.

Camera Calibration

NTSB staff collected measurements of reference points in the fields of view of the three cameras. These points included corners of buildings and windows, light pole locations and heights, locations of trees, locations and heights of fence posts, etc. The locations of the cameras were also measured. Measurements from Google Earth generated additional reference points. The three cameras used wide-angle lenses that caused barrel distortion. The distorted video images were mathematically corrected before they were analyzed. Mathematical models of the optics of the three cameras were then generated using the camera locations and locations of the reference points. It was done in an iterative process in which the fields of view of the cameras and camera orientations were varied until the models generated synthesized video frames in which the reference points closely coincided with their images in the corrected frames from the real videos.

Estimating Airplane Locations

NTSB staff generated an estimated flight path of the airplane based on simple flight simulation, shadow of the airplane seen in a video, the airplane impact point on the building, and angle of wreckage scatter across the building. This estimate was the projection of the airplane 3D trajectory on the ground plane. It had no time information.

The calibrated camera models were then used to generate markers along the estimated trajectory that the models could superimpose on the frames from the videos. The markers in the analysis segment of the Rockwell camera were spaced horizontally by 20 meters and were at elevations of 25, 32.5 and 40 meters. The markers in the analysis segment of the Side Drive camera were spaced horizontally by 5 meters and were at elevations of 13, 14, 15, 16, 17 and 18 meters. The markers in the analysis segment of the Parking Lot camera were spaced horizontally by 10 meters and were at elevations of 15, 17.5, 20, 22.5, and 25 meters.

The estimation of the airplane location in ground coordinates was performed by locating the airplane in a frame from the video with respect to the markers that were superimposed on the frame. Since the locations of the markers in ground coordinates were known, interpolation in between the markers could be used to estimate the location of the airplane at the time corresponding to the time of the analyzed video frame. Each analyzed frame yielded the XYZ location of the airplane at one specific time.

Trajectory and Speed Estimation

As seen in Figure 1, the analysis segment of the Side Drive camera is within the analysis segment of the Parking Lot camera. Therefore, the analyses of these two camera videos were merged to generate one estimate covering the segment of the Parking Lot camera. As also seen in Figure 1 is a gap between the segments of the Rockwell camera and the Parking Lot camera. Interpolation was used to estimate airplane locations in this segment.

With the XYZ locations of the airplane known at video frame times, it was possible to estimate the speed of the airplane. Figure 2 shows the estimated horizontal ground speed of the airplane. It is shown over the analyzed period of approximately 8.3 seconds. The trajectory in Figure 1 marked the end points of the camera segments with letters A, B, C, D, E, F and G. These points were superimposed on the speed estimate in Figure 2 to allow correlation between speed, location and time.

Figure 3 shows the estimated rate of climb. Note that after approximately 0.5 seconds, the rate is negative because the airplane is descending.

Figure 4 shows the estimated horizontal, vertical and total ground speeds. The total speed, defined as the vector sum of the horizontal and vertical speeds, is very close to the horizontal speed estimate because the vertical speed magnitude is relatively low.

Figure 5 shows the estimated altitude of the airplane. Trajectory points A, B, C, D, E, F and G were superimposed on the altitude estimate to allow correlation between altitude, location and time.

E. CONCLUSIONS

Videos from three cameras were analyzed to estimate the trajectory and speed of an airplane that crashed at the Wichita Mid-Continent Airport. Horizontal, vertical and total ground speeds and the airplane AGL altitude were estimated and plotted versus time.

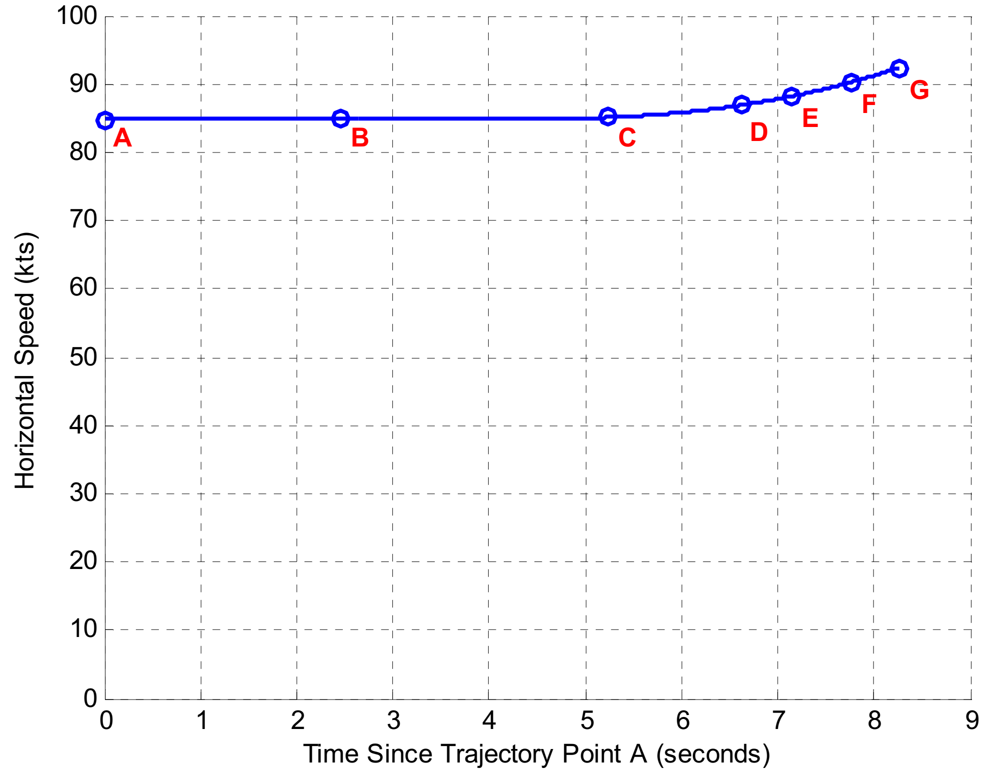

Figure 2 Estimated Horizontal Ground Speed of the Airplane

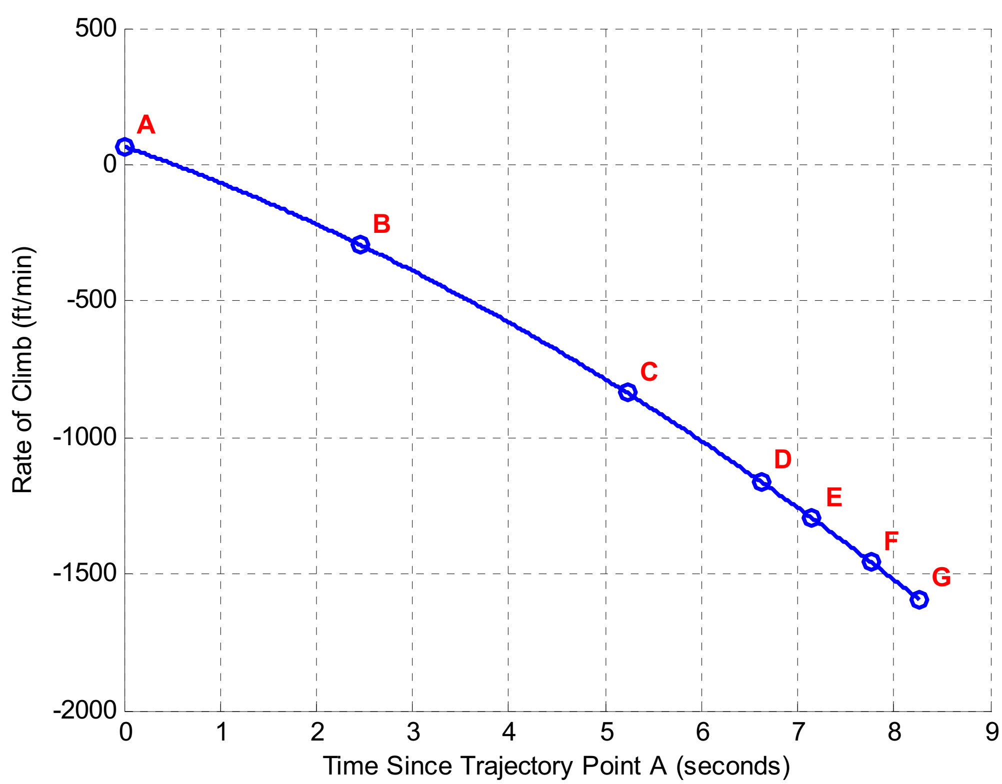

Figure 3 Estimated Rate of Climb (negative values indicate rate of descent)

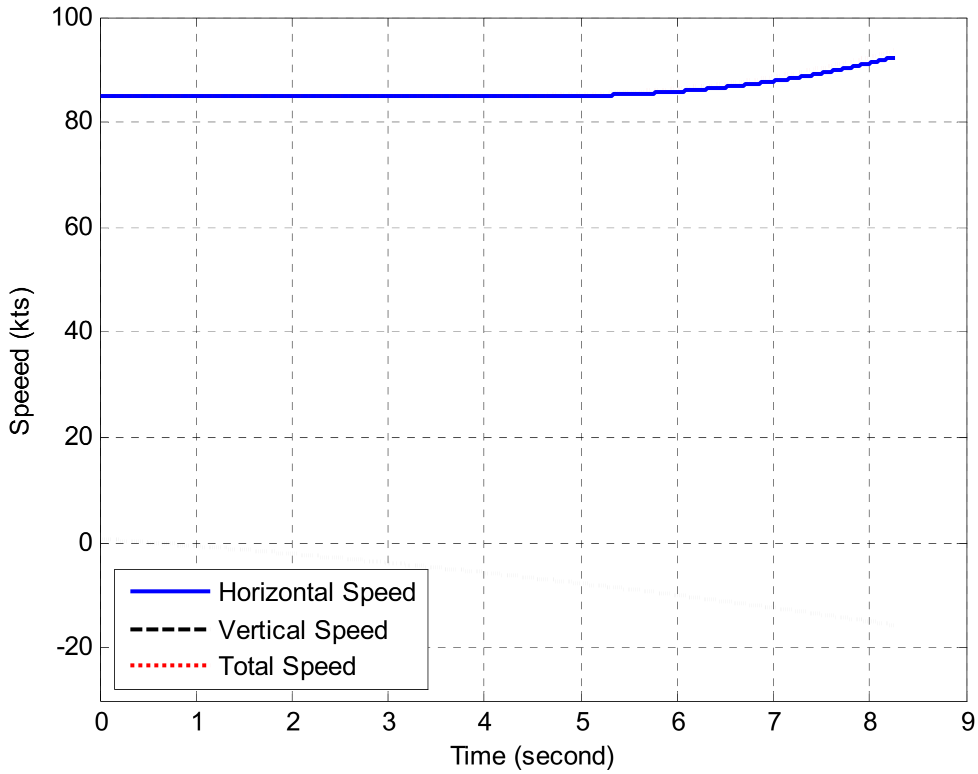

Figure 4 Estimated Horizontal, Vertical and Total Ground Speeds of the Airplane

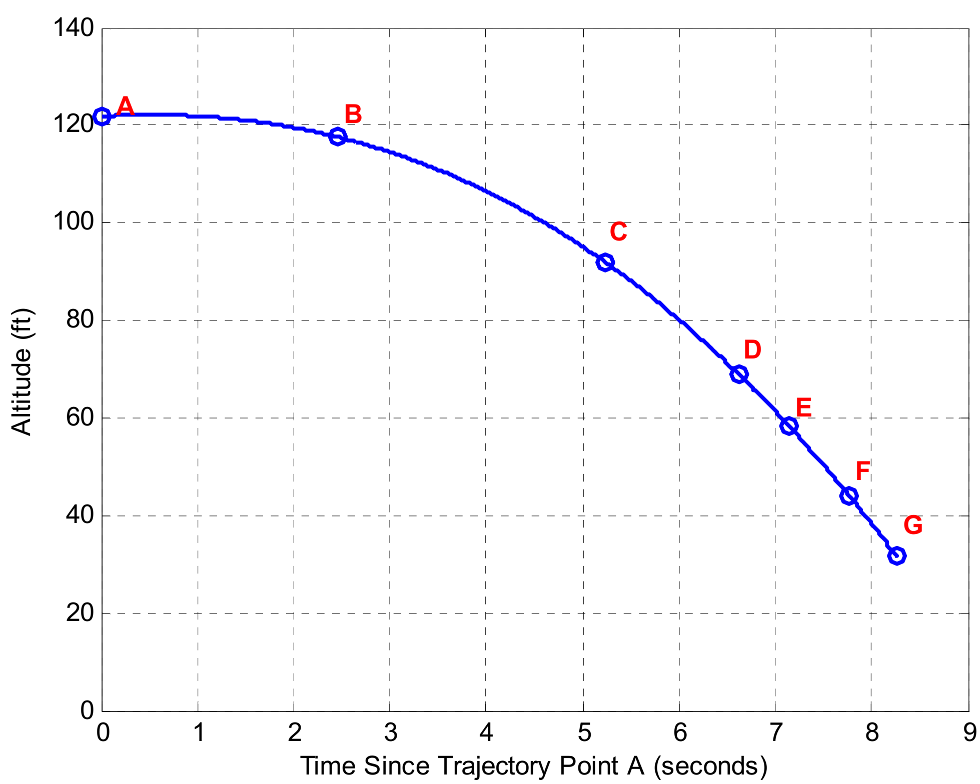

Figure 5 Estimated AGL Altitude of the Airplane