NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Ashburn, Virginia 20147

May 22, 2014

Radar Based Performance Study

ERA13FA253

John Clark

ACCIDENT

Location: Johnstown, NY
Date: May 24, 2013
Time: 2110 GMT,
Aircraft: Piper PA34-200T, N31743
NTSB: ERA13FA253
IIC: A Diaz

SUMMARY

On May 24, 2013, at 2110 GMT, a Piper PA34-200T airplane broke up inflight following a rapid loss of altitude and resulting increase in airspeed. The airplane was destroyed upon ground contact. The pilot and two passengers were killed in the accident and there were no reported ground injuries.

Instrument meteorological conditions prevailed along the route of flight. The airplane flew generally to the northwest at 8,300 feet mean sea level (MSL) at 130 knots calibrated airspeed (KCAS[1]). The airplane was expected to turn to the west, but instead turned to the north. Within about one minute the airplane entered a 400-degree descending turn to the left. The airplane descended about 3,700 feet in 36 seconds, accelerated to about 240 KCAS or 255 KTAS and broke up.

[1] The conditions were established using recorded radar data and airplane performance data. The data are presented in the Radar Performance Study.

Performance Simulation Program

The flight path study is determined by using a simple flight simulation program to match motion history of the airplane. The motion history is based on recorded GPS or radar data that provides time, position, and altitude data.

Other information used in the simulation are 1) winds aloft and temperatures[2], 2) crash site location, and 4) airplane data such as power, drag coefficients, wing area and weight. Estimated time histories of roll angle and normal acceleration (G) [3] are also provided. The simulation program is used to calculate time based performance parameters such as position (flight path), airspeed, ground speed, and flight path angle (climb or descent). The calculated position data is then compared to the recorded position in order to further refine the input data such as roll angle and Gs. Adjustments to thrust and drag are made if there is a marked change in airspeed that may occur at breakup or pilot intervention during the maneuver.

The flight paths calculated by this program will not disclose short term maneuvers between recorded data points, if in fact such maneuvers existed. However, the program is sufficiently accurate to "fly" the airplane through or near the data points and provide valuable insight into the motion of the airplane.

The flight path data is often used in conjunction with breakup trajectory studies to determine the performance parameters, such as altitude, speed and dive angle at the moment of breakup.

RADAR DATA

TIME	N-S	E-W	ALT
(sec)	nm	nm	ft
37.4	0.030	0.030	8300
42.1	0.122	0.104	8300
46.8	0.348	0.301	8300
51.5	0.460	0.400	8300
56.2	0.571	0.455	8300
60.9	0.773	0.441	8200
65.6	0.920	0.303	7800
70.3	0.940	0.070	
75.0	0.826	-0.084	
79.7	0.630	0.000	6700
84.4	0.540	0.240	
89.1	0.666	0.321	5000
99.0	0.666	0.321	5000

[3] G is a measure of flight load on the airplane (G=lift/weight or a/g where "a" is acceleration and "g" is acceleration due to gravity).

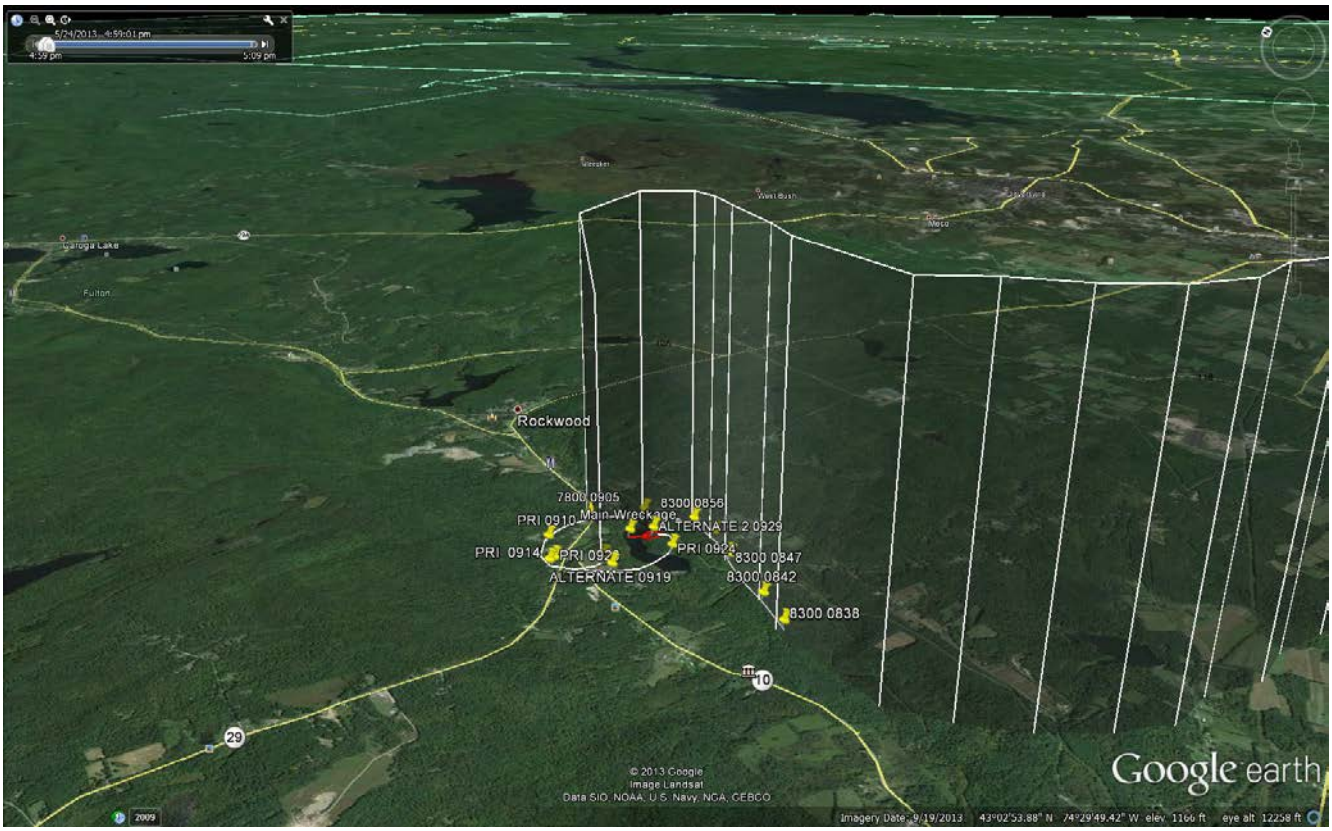


Figure 1 – View of flight path and crash site.

The radar data were converted from a latitude/longitude format to an X-Y. The zero reference point used to establish the offsets presented below is the initial GPS position from above: 34.40927, 84.01110.

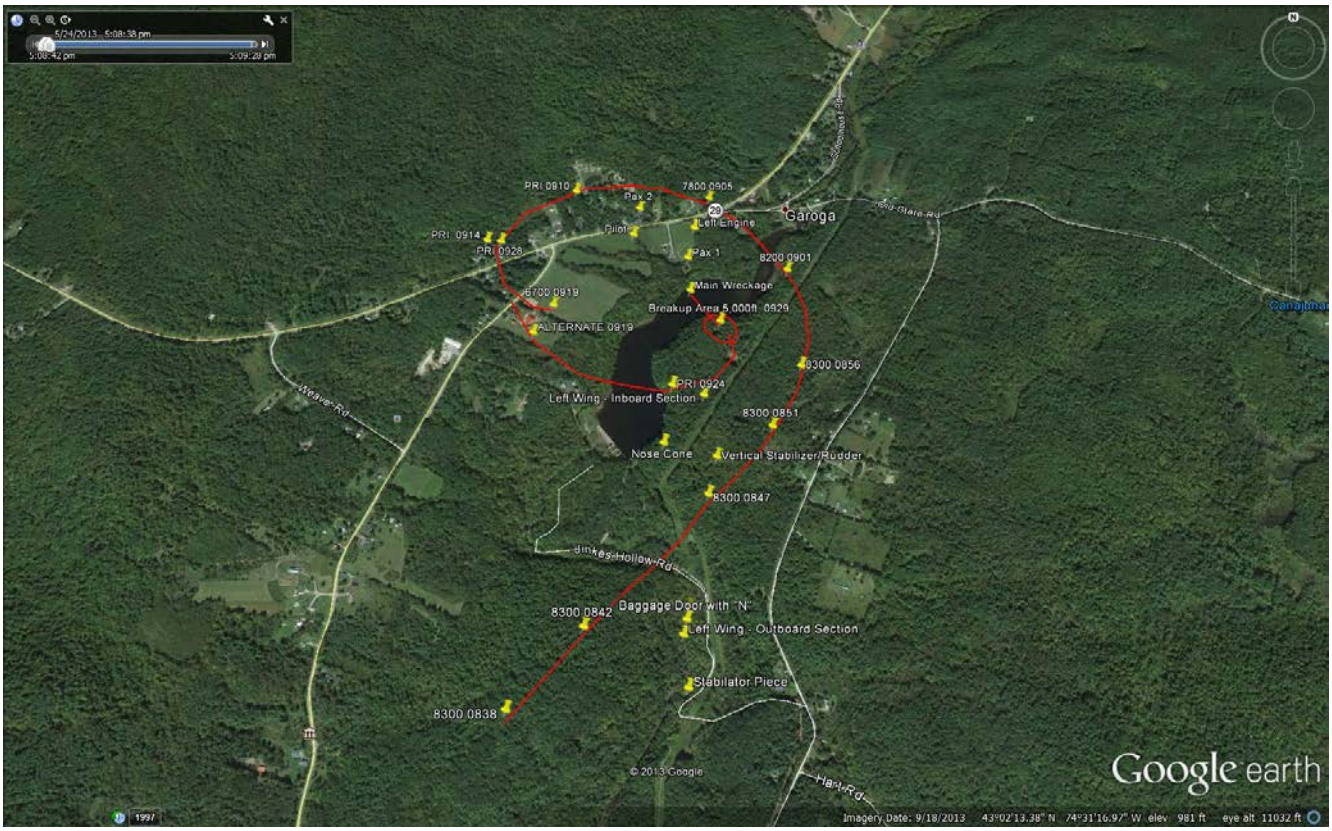


Figure 2 - View of flight path and crash site.

WINDS ALOFT

ALT (ft msl)	DIR (T)	VEL (KT)	TEMP(F)
260.0	291.0	4.0	47.0
280.0	347.0	4.0	48.0
360.0	279.0	6.0	45.0
640.0	296.0	9.0	44.0
940.0	313.0	7.0	43.0
1230.0	341.0	7.0	42.0
1620.0	340.0	12.0	40.0
1750.0	335.0	13.0	40.0
1900.0	19.0	13.0	39.0
2050.0	9.0	12.0	38.0
2240.0	20.0	10.0	38.0
2500.0	39.0	8.0	37.0
3020.0	22.0	10.0	35.0
3350.0	10.0	13.0	34.0
3530.0	20.0	17.0	33.0
4130.0	5.0	19.0	32.0
4780.0	356.0	17.0	30.0
5320.0	348.0	15.0	29.0
6500.0	355.0	13.0	27.0
7340.0	110.0	9.0	36.0
8430.0	157.0	9.0	33.0
9510.0	195.0	9.0	31.0

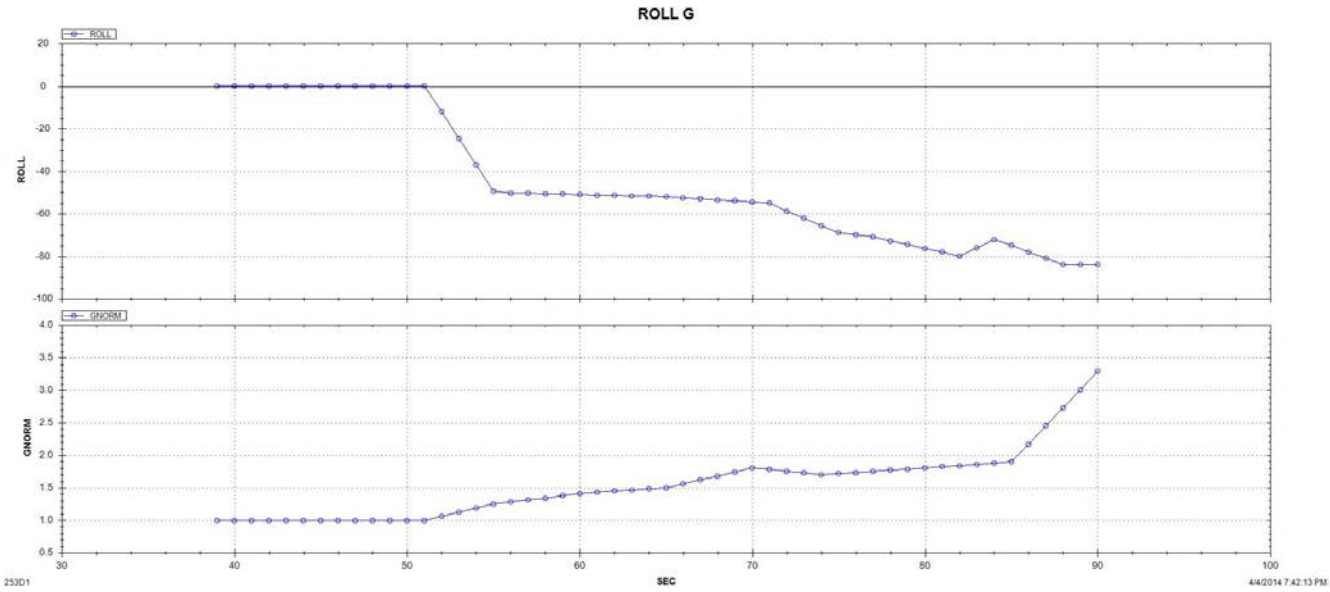
INITIAL CONDITIONS

The initial conditions were estimated using GPS data and airplane reference data.

Initial position 34.40927, 84.01110 or 0,0.
Ground Speed 150.0 knots
Ground Track 40.0 degrees true
Starting Altitude 8300.0 ft msl
Ending Altitude 4600.0 ft msl
Flight Path Angle 0 degrees
Weight 3500 pounds
Engine HP 220 hp (decreased to 40% at 45 seconds)
Wing Ref Area 208.0 ft^2
Cd_0 0.025

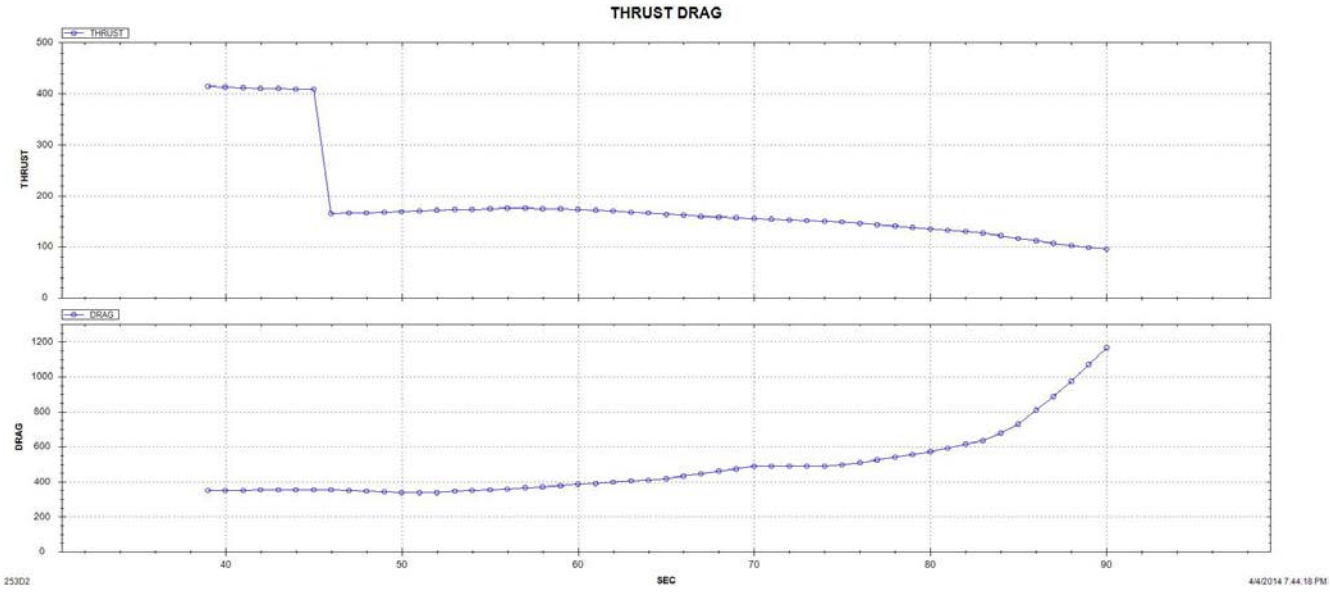
ROLL – Gnorm TIME HISTORY

The roll angle and normal acceleration time histories were developed to generate a flight path that would match the positions defined by radar data.



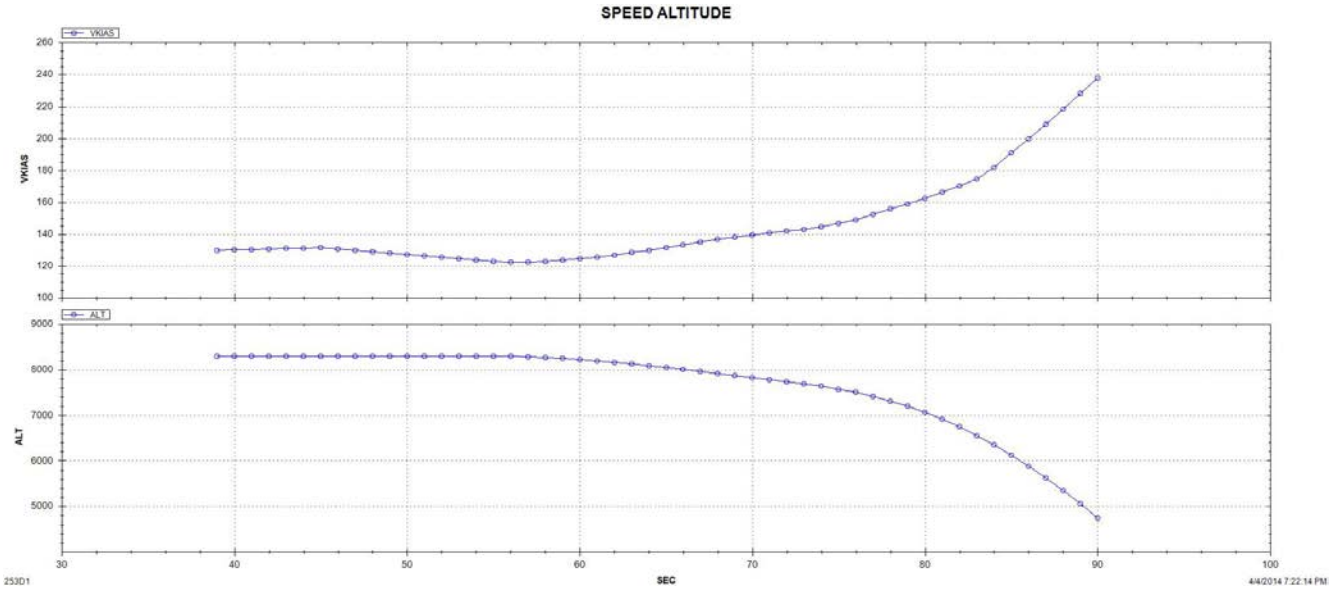
THRUST and DRAG TIME HISTORY

Thrust was reduced by 60% at 45 seconds.

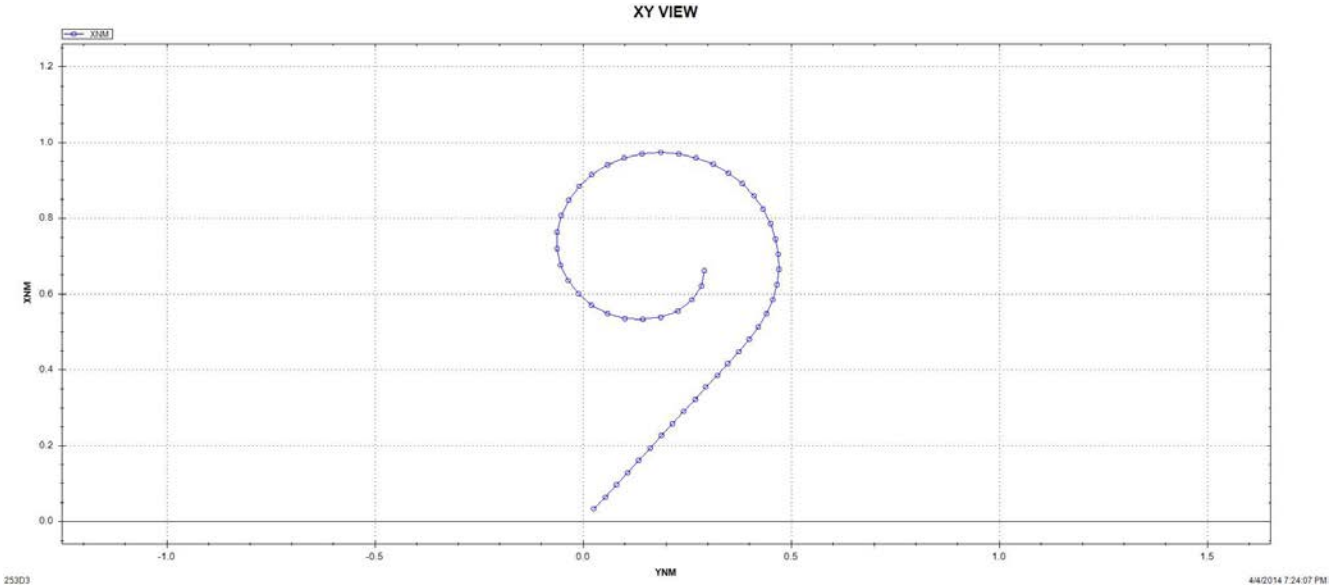


The resulting time histories show the airplane performance leading up to the breakup and after. During the final maneuver, the airplane lost about 3,700 feet of altitude, accelerated to about 240 KCAS or 255 KTAS, and turned about 390 degrees in 36 seconds.

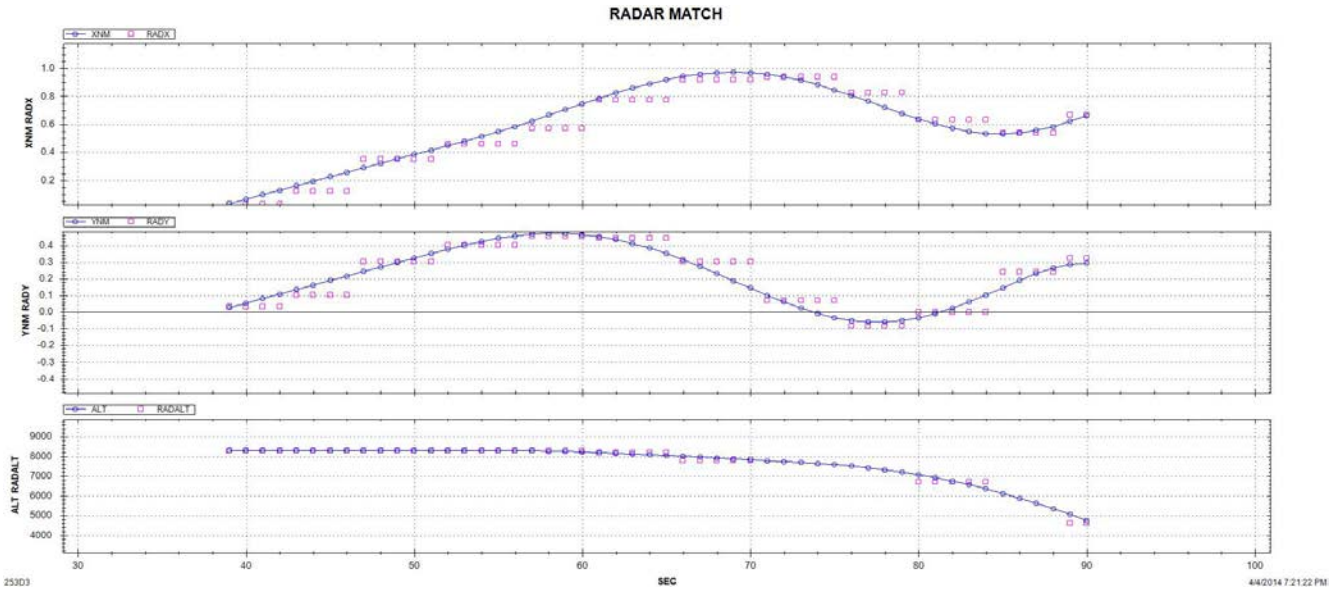
SPEED and ALTITUDE



GROUND TRACK – DERIVED



DATA MATCH



The solution presented should be considered representative of a maneuver that produces a reasonable match of the recorded radar data. Small changes to the time histories will also produce reasonable matches of the radar data. However, the large loss of altitude in a short amount of time would result in the airspeed increasing to near 240 KCAS or 255KTAS.

John Clark
Senior Technical Advisor
Office of Aviation Safety

Appendix: Data File

H	M	SEC	XNM	YNM	ALT	VKIAS	VTOT	HEAD	ROLL	BETA	GNORM	GAMMA
0	0	39	0.032	0.027	8300	129.8	248.6	43.3	0.0	0.0	1.0	0.0
0	0	40	0.064	0.054	8300	130.1	249.2	43.3	0.0	0.0	1.0	0.0
0	0	41	0.096	0.081	8300	130.4	249.8	43.3	0.0	0.0	1.0	0.0
0	0	42	0.128	0.108	8300	130.7	250.3	43.3	0.0	0.0	1.0	0.0
0	0	43	0.16	0.135	8300	131.0	250.9	43.3	0.0	0.0	1.0	0.0
0	0	44	0.193	0.162	8300	131.2	251.4	43.3	0.0	0.0	1.0	0.0
0	0	45	0.225	0.189	8300	131.5	251.9	43.3	0.0	0.0	1.0	0.0
0	0	46	0.257	0.216	8300	130.6	250.1	43.3	0.0	0.0	1.0	0.0
0	0	47	0.289	0.243	8300	129.7	248.4	43.3	0.0	0.0	1.0	0.0
0	0	48	0.321	0.27	8300	128.9	246.8	43.3	0.0	0.0	1.0	0.0
0	0	49	0.353	0.296	8300	128.0	245.1	43.3	0.0	0.0	1.0	0.0
0	0	50	0.384	0.323	8300	127.2	243.5	43.3	0.0	0.0	1.0	0.0
0	0	51	0.416	0.349	8300	126.4	242.0	43.3	0.0	0.0	1.0	0.0
0	0	52	0.447	0.375	8300	125.6	240.4	42.4	-12.0	0.0	1.1	0.2
0	0	53	0.479	0.4	8302	124.7	238.7	39.8	-24.5	0.0	1.1	0.4
0	0	54	0.512	0.422	8303	123.7	236.8	35.1	-37.0	0.0	1.2	0.3
0	0	55	0.547	0.442	8303	122.9	235.3	28.6	-49.5	0.0	1.3	-0.6
0	0	56	0.584	0.456	8298	122.5	234.5	21.0	-50.2	0.0	1.3	-2.1
0	0	57	0.624	0.466	8287	122.5	234.5	13.1	-50.4	0.0	1.3	-3.4
0	0	58	0.664	0.471	8270	122.8	235.2	5.1	-50.6	0.0	1.3	-4.6
0	0	59	0.704	0.47	8249	123.5	236.4	356.9	-50.8	0.0	1.4	-5.7
0	0	60	0.745	0.464	8224	124.5	238.2	348.5	-51.0	0.0	1.4	-6.5
0	0	61	0.785	0.452	8195	125.6	240.3	340.0	-51.2	0.0	1.4	-7.3
0	0	62	0.823	0.434	8163	126.9	242.7	331.4	-51.4	0.0	1.5	-8.0
0	0	63	0.858	0.411	8128	128.4	245.3	322.8	-51.6	0.0	1.5	-8.7
0	0	64	0.89	0.383	8089	129.9	248.2	314.2	-51.8	0.0	1.5	-9.2
0	0	65	0.918	0.35	8048	131.6	251.2	305.5	-52.0	0.0	1.5	-9.7
0	0	66	0.941	0.314	8005	133.3	254.3	296.6	-52.5	0.0	1.6	-10.1
0	0	67	0.958	0.273	7960	135.0	257.3	287.5	-53.0	0.0	1.6	-10.2
0	0	68	0.969	0.231	7914	136.6	260.2	278.0	-53.5	0.0	1.7	-10.2
0	0	69	0.973	0.187	7868	138.1	262.8	268.2	-54.0	0.0	1.7	-10.0
0	0	70	0.969	0.142	7823	139.4	265.1	258.1	-54.5	0.0	1.8	-9.7
0	0	71	0.958	0.099	7779	140.6	267.1	247.9	-55.0	0.0	1.8	-9.4
0	0	72	0.94	0.059	7735	141.7	269.1	237.7	-58.8	0.0	1.8	-9.6
0	0	73	0.914	0.022	7688	142.9	271.2	227.2	-62.2	0.0	1.7	-10.5
0	0	74	0.883	-0.009	7635	144.4	274.0	216.6	-65.5	0.0	1.7	-12.1
0	0	75	0.846	-0.034	7573	146.5	277.6	205.8	-68.9	0.0	1.7	-14.2
0	0	76	0.806	-0.051	7499	149.0	282.2	194.7	-70.0	0.0	1.7	-16.6
0	0	77	0.763	-0.061	7412	152.2	287.9	183.5	-71.0	0.0	1.8	-19.0
0	0	78	0.719	-0.061	7312	155.8	294.2	172.0	-72.7	0.0	1.8	-21.6
0	0	79	0.676	-0.053	7196	159.0	299.8	160.0	-74.5	0.0	1.8	-24.5
0	0	80	0.635	-0.035	7063	162.5	305.9	147.6	-76.3	0.0	1.8	-27.6
0	0	81	0.6	-0.01	6913	166.3	312.2	135.0	-78.1	0.0	1.8	-31.0
0	0	82	0.57	0.022	6743	170.2	318.8	122.2	-79.9	0.0	1.8	-34.6
0	0	83	0.548	0.059	6552	174.4	325.7	109.3	-76.2	0.0	1.9	-38.0
0	0	84	0.535	0.101	6343	182.0	338.9	96.6	-72.2	0.0	1.9	-39.8
0	0	85	0.532	0.145	6119	190.8	354.1	83.8	-74.9	0.0	1.9	-41.0
0	0	86	0.538	0.188	5878	199.8	369.3	70.1	-77.9	0.0	2.2	-42.4
0	0	87	0.555	0.229	5621	208.9	384.5	54.7	-80.9	0.0	2.5	-43.9
0	0	88	0.583	0.263	5345	218.1	399.8	37.4	-83.9	0.0	2.7	-45.6
0	0	89	0.62	0.285	5050	228.3	416.6	18.7	-84.0	0.0	3.0	-47.1
0	0	90	0.661	0.292	4736	238.0	432.0	357.0	-83.9	0.0	3.3	-48.4