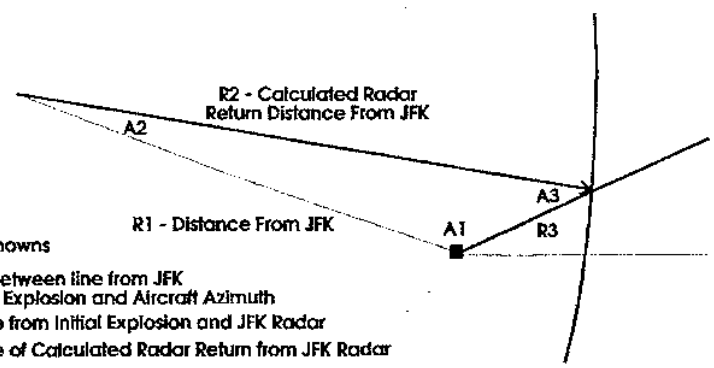
A Study of the JFK 4.6 Second Radar and
Its Effect on the TWA Flight 800 Trajectory Model

New FBI-provided radar data from the JFK 4.6 second radar has not resulted in a substantial change in the CIA scenario of what happened to TWA Flight 800.

In order to use the new JFK radar data (presented in Appendix A), the radar returns from the aircraft's main body have to be determined. FBI investigators identified several potential radar returns for the trajectory of the main body. However, several of the points exhibit large out-of-plane maneuvers and other time periods have no radar returns associated with them. The JFK radar measures both the azimuth and the distance to place each radar return on a map. The most accurate radar measurement is the distance, with most errors occurring on the azimuth measurement. The total distance from the JFK radar site can be determined by taking the root-sum-square of the downrange and crossrange distances. By determining the intersection of this distance from JFK, along an assumed azimuth[1] from the initial explosion, the distance form the initial explosion can be determined.

Figure 1:

Problem: Solve for the distance R3, from the intersection of the JFK radar measured distance, R2, along a given flight azimuth, from the initial explosion.



Knowns

A1 - Angle between line from JFK to Initial Explosion and Aircraft Azimuth
R1 - Distance from Initial Explosion and JFK Radar
R2 - Distance of Calculated Radar Return from JFK Radar

From the Law of Sines

$$A3 = \sin^{-1}(\sin(A1)*(R1/R2))$$

and

$$A2=180-A1-A3$$

$$R3 = R2*\frac{\sin(A2)}{\sin(A1)}$$

The calculated distances of each radar return from the initial explosion, R3, was plotted against the time of its return and the most likely trajectory for the aircraft's main body was determined(figure 2, 3). The resulting time and distance traveled for each radar point was used as the basis of a trajectory reconstruction of the aircraft following the initial explosion.

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[1] Based on the JFK radar plots, it is likely the main body flew in a fairly constant azimuth for about 30 seconds.

Two scenarios were investigated. In the first scenario, the nose of the aircraft separated very soon after the initial explosion at 0831:12. The second scenario involved keeping the nose attached until 0831:16, or 4 seconds later. For each scenario, the horizontal distance traveled for each radar return had to be matched, starting with the aircraft's initial conditions, and the total flight time had to be approximately 50 seconds[2].

Scenario 1: Nose Off at 0831.12

The first scenario data points, based on the nose coming off at 0831:12, and the modeled match are shown in Table 1.

Table 1: Comparison of Calculated and Modeled Aircraft Locations

Time from 0831:12	Distance Traveled Calculated from Radar	Distance Traveled Modeled
4.77	3082 ft	3033 ft
9.37	5823 ft	5857 ft
14.00	8361 ft	8168 ft
18.60	10027 ft	9807 ft
23.00	11027 ft	11183 ft
27.84	11693 ft	12114 ft
32.48	12890 ft	12932 ft
37.08	13755 ft	13951 ft

The modeled reconstruction gives a very good match to the JFK radar data.

The resulting reconstruction is shown in figures 4-7, showing the distance, altitude, and speed of the main body. The main body started a slow pitchup shortly after the initial explosion, and really started to climb about 5 seconds later. The aircraft eventually reached an altitude of almost 16000 feet, before descending to an altitude of 4950 feet at 41 seconds, close to the wing separation time. Although the aircraft does not ascend quickly (figure 5), to eyewitnesses on Long Island the aircraft would still appear to be rising since it is approaching their location[3].

A trajectory based on the aircraft initially descending was also attempted. However, an examination of the change in horizontal distances based on the JFK radar data (Table 2) show why the model could not be made to fit this assumption.

Table 2: Distance Traveled Between Calculated Aircraft Locations

Time from 0831:12	Distance Traveled Calculated from Radar	Delta Distance Traveled	Average Horizontal Velocity
4.77	3082 ft	3082 ft	646 ft/sec
9.37	5823 ft	2741 ft	596 ft/sec
14.00	8361 ft	2538 ft	548 ft/sec
18.60	10027 ft	1666 ft	362 ft/sec
23.00	11027 ft	1000 ft	227 ft/sec
27.84	11693 ft	666 ft	138 ft/sec
32.48	12890 ft	1197 ft	258 ft/sec
37.08	13755 ft	865 ft	188 ft/sec

Initially, the horizontal distance traveled is close to the aircraft's initial speed, indicating that the aircraft did not pitch up nor down *substantially* for the first 5 seconds. However, the quick loss of horizontal

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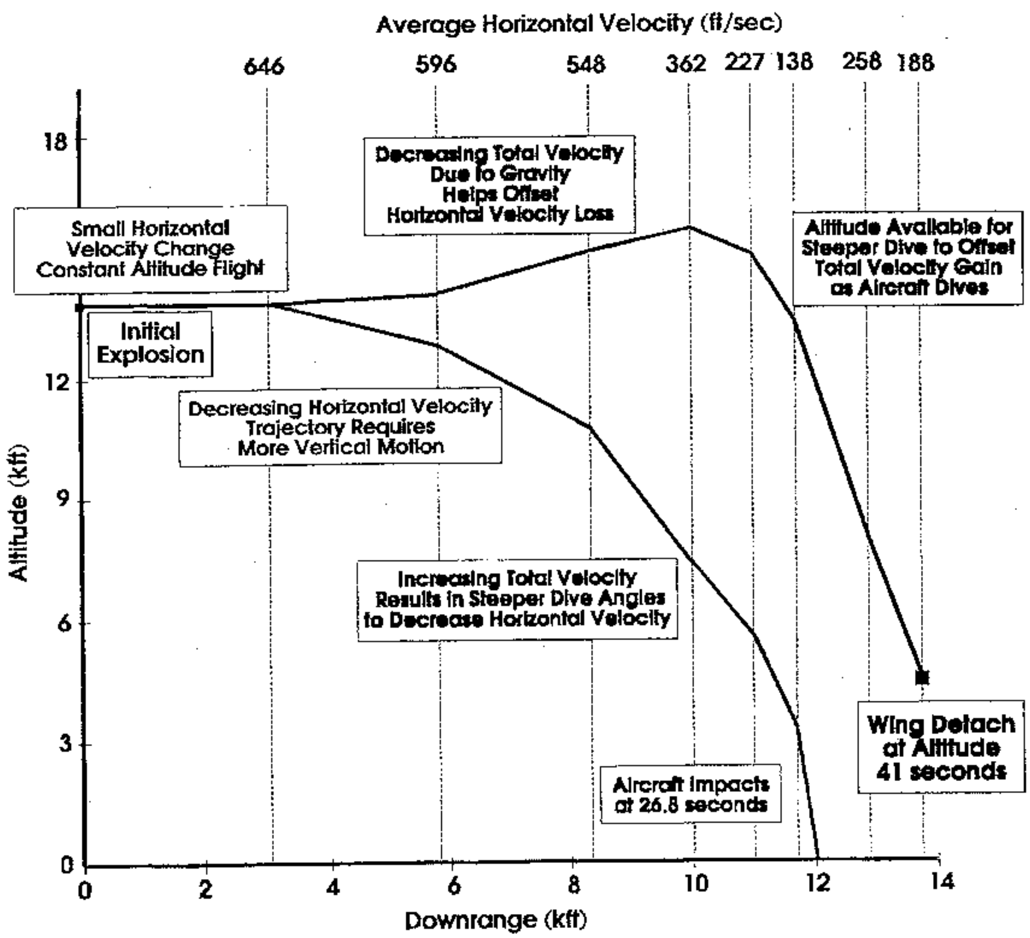
[2] Based on sound propagation analysis of the initial explosion sound.

[3] This trajectory is similar to the one used in the TWA 800 video, which clearly shows the initial white light rising relative to Michael Wire's perspective.

speed up to 28 seconds is more than drag forces alone can accomplish, requiring some motion in the vertical. If this motion is upward, then the aircraft's total velocity will slow more due to working against gravity. If the aircraft's motion is downward, then the aircraft's total velocity is increased due to a gravity assist. However, as the aircraft's total speed is increased for the pitch down case, the horizontal speed continues to slow according to the JFK radar hits. This is only possible if the aircraft continues to dive in a steeper and steeper angle. Eventually, the aircraft no longer has any altitude left to allow for a steep dive angle, resulting in the aircraft either impacting to soon, or developing a very large horizontal speed error. On the other hand, if the initial motion is upward, the aircraft gains altitude which can be used to increase the aircraft's dive angle later in its flight to offset the high speeds due to the gravity assist on the downward leg.

Figure 8:



Scenario 2: Nose Off at 08:31.16

The second scenario data points, based on the nose coming off at 0831:16, and the modeled match are shown in Table 3.

Table 3: Comparison of Calculated and Modeled Aircraft Locations

Time from 0831:16	Distance Traveled Calculated from Radar	Distance Traveled Modeled	Average Horizontal Velocity
4.60	2741 ft	2872 ft	596 ft/sec
9.23	5279 ft	5320 ft	548 ft/sec
13.83	6945 ft	6941 ft	362 ft/sec
18.46	7945 ft	8452 ft	216 ft/sec
23.07	8611 ft	9295 ft	144 ft/sec
27.71	9808 ft	9808 ft	258 ft/sec
32.31	10673 ft	10615 ft	188 ft/sec

The modeled reconstruction gives a very good match to the JFK radar data except at the 23.07 second data point. The modeled downrange, altitude and velocity are shown in figures 8-11 The trajectory required a much steeper climb sooner due to quick drop off in horizontal speed, however, the apogee was still only 16100 feet, slightly higher than the first scenario.

A comparison of the pitch angles of the two trajectories (figure # and #) show that the first scenario, with the early nose separation, resulted in a smaller pitch rates as compared to the second scenario. Although both scenario trajectories can be fit, the smoother pitch angle history of the first scenario indicate that it is most likely the actual one.