

MANUAL OR AUTOMATED?

A Flight Simulation Study and Analysis of Reported
Aircraft Maneuvers on September 11, 2001



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International Center for 9/11 Justice
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About the Author

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Disclaimer

The views expressed in this report are those of the author and do not necessarily reflect the official position of the International Center for 9/11 Justice.

EXECUTIVE SUMMARY

The Research

Official reports, 3-D modeling of flight path data, and flight simulations performed by eight pilots in a full motion flight simulator were used to evaluate the likelihood of manual versus automated control of the aircraft reported to have struck the World Trade Center Towers in New York and the Pentagon in Arlington, VA, on September 11, 2001.

Key Findings and Conclusions

1. Hitting the Twin Towers and the Pentagon under manual control and at high speed would not have been inherently difficult. Direct and readily accomplishable routes were available for the aircraft that reportedly struck these buildings. In all three cases, the aircraft could have been flown in straight lines toward the intended targets. These “**direct routes**” could have avoided the demanding maneuvers that the three aircraft reportedly performed in the final minutes and seconds of flight. The direct routes each had high completion rates in this study. If the aircraft were under manual control, it is these direct routes, effectively “making a beeline” to the target and avoiding unnecessarily demanding maneuvers, that one would expect to have seen on 9/11.
2. Although direct and readily accomplishable routes were available, the actual reported flight paths were indirect. From the point of reported takeover, each flight followed a route involving multiple legs during which the aircraft was not flying directly toward the target. When nearing the target, during the final minutes and seconds of the reported flight paths, the aircraft performed unnecessarily demanding and counter-intuitive maneuvers that were illogical from a piloting perspective. In the case of the routes into the Twin Towers, these maneuvers included, within approximately 10 seconds of hitting each tower, pull-outs from rapid descents coupled with sharp banked turns necessary to align with the towers. In the case of the reported route into the Pentagon, the maneuvers included a 330-degree descending turn “orbit” followed by an extremely low pull-out to fly level across the ground just in front of the Pentagon. We labeled these maneuvers in this study as the “**indirect route maneuvers.**”
3. These final maneuvers were inherently difficult, though not impossible, to successfully execute. The completion of them required precision flying that also likely necessitated prior knowledge of how the aircraft handled at high speed. On first attempt, by definition, the alleged hijackers could not have possessed this knowledge. The maneuvers involved in both of the indirect routes had low completion rates in this study. If the maneuvers had been



manually flown, one would reasonably expect the pilots to fail to complete these maneuvers on first attempt.

4. The reported final flight paths for all three aircraft are consistent with deliberate and precise targeting. Both of the aircraft that hit the Twin Towers were maneuvered in the final seconds so as to achieve a completely or nearly perpendicular path into the face of each building, impacting at or near the center. Moreover, the earlier phases of these flights, after the reported point of takeover, involved a series of maneuvers that brought the aircraft into a position from which the final perpendicular tracks could be flown. Both aircraft also exhibited rapid descents and pull-outs in the final seconds before impacting the buildings. The symmetry between the airplanes' last-second dives, pull-outs, turns, and perpendicular line-ups is remarkable. If manually flown, one would expect there to be a much greater degree of difference regarding the approach angles. One would also expect these demanding maneuvers to have been avoided, as observed when pilots flew the direct routes, by both pointing toward the building and descending to its height much sooner.

Meanwhile, the final track of the aircraft reported to have hit the Pentagon involved an extremely low final approach, nearly level with the ground, so that the aircraft impacted the building from the side at ground level, thus avoiding the risk of striking other parts of the building. Conversely, one would expect a manually flown plane to have avoided a 330-degree orbit and descended toward the building at a steeper angle, avoiding the risk of hitting the ground and ensuring a larger visual target to aim for, and to have then impacted the building anywhere between its side and its roof.

Taken together, the flight simulations and analysis of available flight path data support the hypothesis of automated control involving both precision control inputs in the final seconds and the execution of specific maneuvers that achieved particular impact angles and points of impact. These findings do not support the hypothesis that either low- or high-experience hijackers manually flew the aircraft with the sole objective of hitting the intended targets. Although manual control is not completely ruled out, it would require several improbable propositions to have occurred across three separate flights, making it extremely unlikely.

These findings contribute to our wider understanding of the events of September 11, 2001. The larger context beyond the airplane strikes is that we now know there was a plan in place that morning to demolish the World Trade Center Twin Towers and Building 7. The evidence for this claim is overwhelming and beyond doubt. Given that knowledge, logical inference strongly suggests that the planners of these events needed to ensure that aircraft hit the Twin Towers in order to have a cover for the destruction of the buildings. The planners would therefore not have relied upon a highly unpredictable plan of would-be suicide hijackers

both successfully commandeering multiple airliners and then successfully flying them into the targets with enough precision to make it appear that the damage was sufficient to cause the collapses. This study, by providing evidence for the automated control scenario, corroborates this inference and, in doing so, strengthens confidence in the overall thesis that 9/11 was a false flag event and not a terrorist attack by Islamic fundamentalists.

OVERVIEW

The 9/11 Commission Report states that four hijackers with low levels of aviation experience were able to fly commandeered commercial airliners and maneuver them at high speeds in complex ways into buildings in New York City and Arlington, Virginia. The aircraft that impacted the South Tower, said to have been United Airlines Flight 175 (UA175), a Boeing 767 that had originally departed from Boston Logan Airport, reportedly struck the tower following a rapid descent from 28,000 feet, sometimes in excess of 6,000 feet per minute (fpm) vertical speed, before pulling out of the dive and turning to align with the tower during the final seconds before impact, striking it at over 575 miles per hour (mph). No flight data recorder (FDR) was retrieved for UA175. The flight path of the aircraft alleged to have struck the Pentagon, said to have been American Airlines Flight 77 (AA77), a Boeing 757 that had originally departed from Dulles Airport near Washington, D.C., involved a controlled and well-paced descending 330-degree turn before aligning with the face of the building approximately 30 seconds out, increasing the power to near maximum while descending at a rate of over 1,000 fpm while close to the ground, and then leveling out a few feet above the grass in front of the Pentagon and striking the ground floor of the building at close to 535 mph. An FDR was retrieved for AA77.

Many commercial pilots have expressed surprise and doubt regarding the likelihood that the accused individuals were capable of performing these maneuvers, and various alternative explanations have been proposed. These range from the alleged hijackers receiving far higher levels of training than previously reported to the use of automated guidance technology.

In order to provide an evidenced-based approach to better understanding these issues, researchers at the International Center for 9/11 Justice (IC911) conducted a study involving a full motion flight simulator and a combination of experienced and inexperienced pilots attempting to replicate the maneuvers reportedly performed by UA175 and AA77 during the final minutes of these flights, as well as other more straightforward flight profiles. Flight path data was also examined for the purposes of this study, and the analysis was eventually

extended to American Airlines 11 (AA11), a Boeing 767 that had departed from Boston Logan Airport and reportedly crashed into the North Tower. No FDR was retrieved for AA11. The results provide further evidence regarding the likelihood of manual versus automated control. A fourth aircraft, United Airlines 93 (UA93), a Boeing 757 that departed from Newark International Airport and reportedly crashed in Shanksville, Pennsylvania, was not examined in this study because the study was focused on the flyability of the completed routes. An FDR was retrieved UA93.

BACKGROUND AND RELEVANT LITERATURE

According to the 9/11 Commission, each commandeered airliner had at least one alleged hijacker capable of piloting the involved aircraft: Mohammed Atta on AA11, Marwan al Shehhi on UA175, and Hani Hanjour on AA77 each reportedly held commercial pilot licenses and had received up to 20 hours of Boeing simulator training; Ziad Jarrah on UA93 held a private pilot license (PPL) and had also received some Boeing simulator training. A 9/11 Commission staff report states:

Whether the hijackers flew the aircraft manually, engaged the flight management computer to take them to a programmed destination, or employed some combination of the two, experts consulted by the Commission believe it quite credible that, given the certificates held by the hijackers, the training and educational opportunities available to them through publicly available flight operations manuals and computer-based flight training software, the hijackers—particularly Atta, Hanjour, and al Shehhi—had the know-how to complete the mission. (9/11 Commission, Staff Statement No. 4, p. 6)

So, although the alleged hijackers had a relatively low level of flying experience, the 9/11 Commission assessed that they possessed the skills necessary to “complete the mission.” Beyond this the 9/11 Commission does not appear to have examined the question of the flyability of the flight maneuvers flown on 9/11. The 9/11 Commission did not interview any commercial pilots.

In contrast, it has often been argued that the flight maneuvers were beyond the capabilities of the alleged hijackers. This argument is especially prevalent in relation to AA77 and its reported descending turn and low-level impact with the side of the Pentagon. Drawing upon newspaper reports and comments by aviation professionals, the *9/11 Consensus Panel* concluded that Hani Hanjour could

not have flown the aircraft that struck the Pentagon (Griffin and Woodworth, 2018: 68-70). Retired airline pilots Captain Ross (Rusty) Aimer and Captain Dan Hanley (9/11 Pilot Whistleblowers) also claim, along with many other professional pilots, that the maneuvers were beyond the ability of low-experience pilots. In particular they cite evidence that Hani Hanjour was reported by several flight instructors to be incompetent (e.g., New York Times, 2002) and to have failed check rides shortly before 9/11. In addition, Aidan Monaghan (2009/2026) analyzed the trajectory and bank of UA175 during its final seconds and assessed that the maneuver likely required computer-aided guidance. Monaghan (2008) has also discussed the availability of a variety of guidance systems and the existence of remote piloting and control systems while *9/11 Pilot Whistleblowers* describe the existence of an “uninterruptable autopilot” system that allows for remote takeover of an airliner and that cannot be disconnected by the pilots. More broadly, precision guidance technology, especially for military weapons systems, has existed for many decades.

There are only two documented studies involving attempts to replicate the maneuvers using a commercial full motion flight simulator. The first was conducted for an American TV series, *Conspiracy Theory with Jesse Ventura*, and used a very inexperienced trainee pilot who did not match the experience levels of the alleged hijackers. He was unable to hit the Pentagon. However, the selection of such an inexperienced pilot inevitably biased the results against the official narrative. In 2006, a Dutch TV company aired *The 9/11 Conspiracy*, which showcased three attempts by a low-experience pilot to replicate AA77’s flight path into the Pentagon. He was able to hit the Pentagon all three times, though at a height well above ground level. Both simulation exercises lacked complete documentation, probably because they were mainly intended for brief TV documentary segments.

Other arguments have been advanced about whether commercial airliners could fly at the high speeds and low altitudes reported on 9/11 — these involve the possibility of aerodynamic flutter, Dutch Roll, Mach Tuck, and engine flameout — and whether different aircraft from the original airliners or any aircraft at all actually struck the buildings. This study is concerned only with the piloting feasibility of the reported flight paths and the question of manual versus automated control. It does not address nor assume a position on these other questions.

With that said, for the sake of readability, this report will assume the 9/11 Commission and National Transportation Safety Board’s account of the aircraft identities, flight paths, and FDR retrievals to be accurate. Accordingly, repetitive qualifiers such as “alleged,” “reported,” and “purported,” though warranted, are omitted.

RESEARCH QUESTION AND APPROACH

An important question arising from the debates described above concerns whether the planes that struck the buildings on 9/11 were manually piloted by the alleged hijackers or if, alternatively, an automated guidance technology was used. In order to provide an empirical basis for evaluating these two scenarios, the reported flight profiles of UA175, AA77, and AA11 were identified and studied, and then a selection of high- and low-experience pilots were tasked with performing a variety of maneuvers in a full motion flight simulator.

Following a search for commercially available flight simulators, a full motion (Category D equivalent¹) Boeing 737 flight simulator was secured for use. NTSB reports (NTSB a, b, c, and d, 2002) and films (Kobs, 2009/2025) were used to identify the flight paths flown by UA175, AA77, and AA11. 3-D modeling using FDR information was used to further characterize AA77's final approach to the Pentagon.

The research proceeded in three stages. At the preliminary stage, two retired, highly experienced pilots, each with military fast jet and commercial airline experience in excess of 10,000 flight hours, evaluated the suitability of the simulator for the proposed study. IC911 Research Director Piers Robinson (this author), who holds a PPL with an Instrument Meteorological Condition (IMC) Rating and has 200 hours flying experience, attempted the flight paths flown by UA175 and AA77 (after having practiced them dozens of times using at-home flight simulator software).

The experienced pilots, referred to in this report as Pilot 1 and Pilot 2, did not fly the flight paths flown on 9/11. Instead, they restricted themselves to evaluating the handling of the simulator at high and low speeds. Pilots 1 and 2 confirmed that the simulator provided a reasonable approximation of how a real Boeing 767 or 757 would handle and that it would be suitable for the study.

The Research Director assessed the basic task of hitting the South Tower and the Pentagon using the easiest route and hitting the buildings anywhere.

- **For the purposes of this study, these were designated as the *direct routes*. They involved a straight flight path from the starting point of the exercise to the building and included no significant deviations or unnecessary maneuvers.**

¹ Category D simulators are certified by competent aviation authorities as accurate simulations of a real aircraft and represent the most realistic of all simulator types.

It was assessed that the direct routes would likely be achieved with relative ease by the high-experience pilots, even at high speed.

It was decided, therefore, that Stage 1 should focus on assessing the difficulties the experienced pilots encountered in attempting to fly the actual flight paths flown on 9/11.

- **For the purposes of this study, these were designated as the *indirect route maneuvers*. They were the actual maneuvers the planes flew, according to visual observation or the official tracks (derived from radar or FDR data).**

The Research Director and Pilots 1 and 2 also agreed that the emphasis should be on exploring how the pilots flew the indirect route maneuvers on their first attempt, since the aircraft hit the buildings first time, and repeated attempts would enable pilots to learn from experience how to fly the maneuver. The possibility that the alleged hijackers practiced the maneuvers on a home or commercial simulator would not alter the fact that flying the maneuver in real life would have been different from previous practice attempts in a simulator, as handling of real aircraft will always be different when compared to a simulator. Moreover, as discussed more fully below, it is implausible that the alleged hijackers would have practiced the specific maneuvers flown. Focus on first attempts is therefore a valid methodological approach for this study.

Stage 1 included the two highly experienced pilots involved with the preliminary stage (Pilots 1 and 2) and one further practicing commercial pilot with an Air Transport Pilot License (ATPL) and 5,000-plus hours experience (Pilot 3). Pilots 1, 2, and 3 were asked to fly the flight maneuvers flown on 9/11 and then also to make further attempts. As mentioned above, the focus with the high-experience pilots was on the indirect routes, although Pilots 1 and 2 carried out direct routes for the South Tower and Pilot 3 also flew direct routes to the South Tower and the Pentagon.

Stage 2 involved four PPL-qualified pilots whose experience levels were closer to those of the alleged hijackers. Pilot 4 possessed close to 2,000 hours experience, which included flying complex aircraft types; Pilot 5 possessed 150 hours experience; Pilot 6 had just over 300 hours experience; and Pilot 7 had 500 hours experience. During Stage 2, a practicing qualified flying instructor sat in the right-hand pilot seat of the simulator.

All pilots were allowed at least 15 minutes in the simulator to practice handling the aircraft before commencing the runs. The four PPLs were asked to fly the indirect routes and then to fly direct routes using their own judgment about the easiest way to hit the buildings.

FLIGHT PROFILES AND INSTRUCTIONS TO PILOTS

Direct Routes

In this part of the study, pilots were tasked with only having to hit the target and they were asked to fly the route in a way that they judged to be the easiest in order to achieve this goal.

South Tower

For the South Tower, the pilots were started at 10,000 feet above sea level and approximately two minutes flying time (about double the distance of the indirect route discussed shortly) away from the South Tower (see Figure 1 below). It was determined that starting the pilots at the closer starting point of the indirect route would put undue constraint on the route a pilot would choose to take to the target if the goal were merely to hit the building.

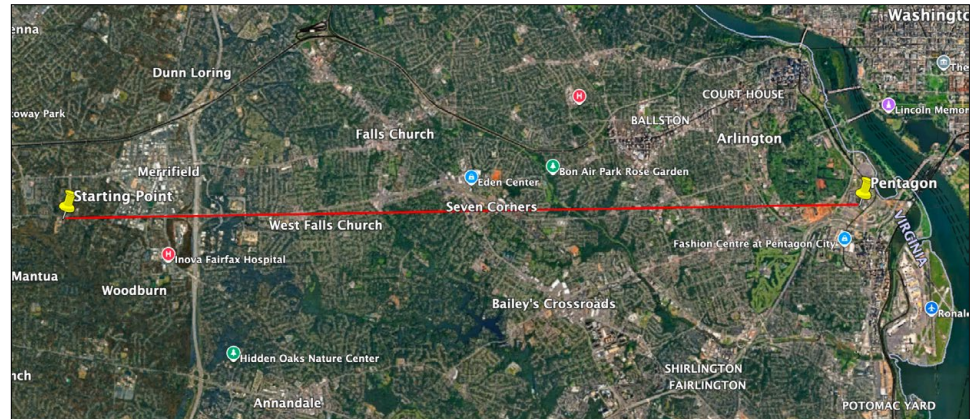
Figure 1: The South Tower direct route.



Pentagon

For the Pentagon, the pilots were started at 7,500 feet above sea level and at the point where AA77 started to turn away from a direct heading toward the Pentagon (see Figure 2 below).

Figure 2: The Pentagon direct route.



Indirect Route Maneuvers

South Tower

Prior to its final phase of flight and according to the NTSB Report (2002a), UA175 was hijacked at about 8:47 a.m. while at an altitude of 32,000 feet (see E in Figure 3 below). The aircraft did not turn immediately toward New York but instead continued flying for 5 minutes in a southwesterly direction before then starting to turn first onto a southerly heading and then onto a southeasterly heading over the course of about 6 minutes. Only after that did the aircraft adopt a northeasterly heading that flew over Staten Island and toward Lower Manhattan. It was the final phase of flight, as the aircraft reached the northern coastline of Staten Island, that was focused on for the indirect route runs. The final 10 seconds of flight involved a steep drop in altitude followed by pull-out — from approximately 1,800 feet down to between 970 and 980 feet, the height at which the plane hit the tower, at up to a 6,000 fpm rate of descent (see Figure 4 below) — combined with a banked 20-degree turn, during which the aircraft finally lined up with the building (NTSB, 2002c; Monaghan, 2011/2026).

Figure 3: NTSB Flight Path Study (NTSB, 2002a) ground track of complete flight path.

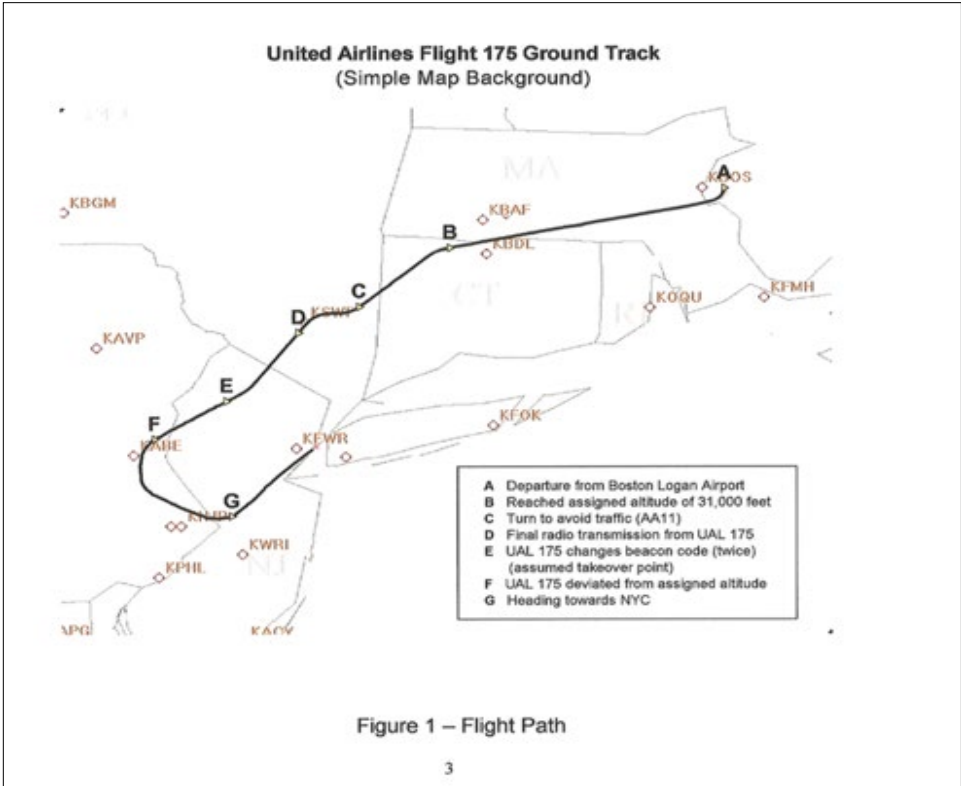
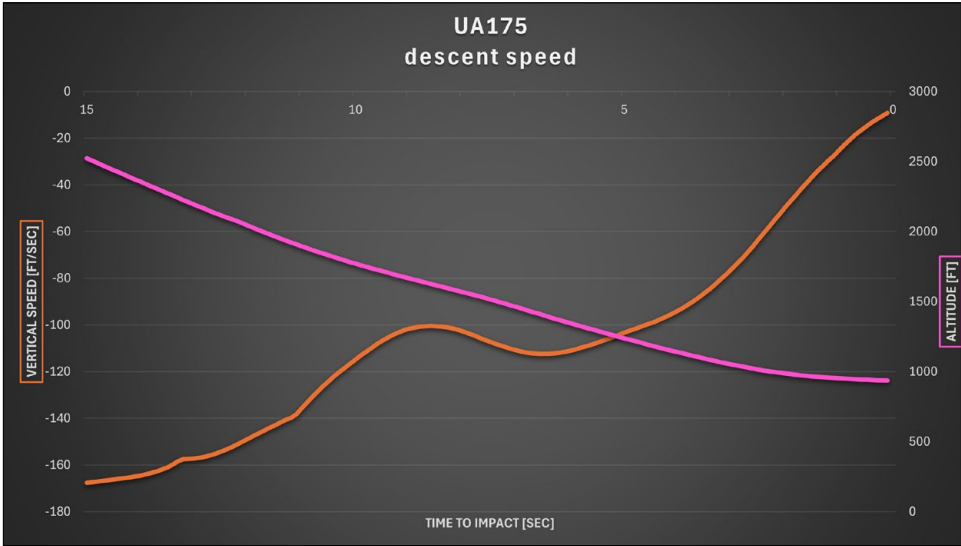


Figure 4: Estimation of vertical speed rate of descent changes during the last 15 seconds of flight (Kobs, 2026). Derived from analysis of NTSB Radar Data Impact Speed Study (2002c).



For the South Tower indirect route maneuver, the pilots were started at 7,500 feet above sea level and approximately one minute flying time before impact. Weather conditions were set to clear, as was the case on the day in question, while wind speed and direction, plus aircraft fuel and passenger loadings, were also added. Pilots were asked to maintain an offset to the right of the South Tower and then, at the command of the Research Director at around 10 seconds prior to impact,

initiate the turn maneuver in order to hit the tower (see Figures 5, 6, 7 and 8 below). Pilots were fully aware that, when instructed to by the Research Director, they would be attempting to turn the aircraft in order to hit the building. Flight speed was approximately 575 mph. For Stage 2, the instructions were refined to include advice that a specific heading — 063-degrees magnetic — be flown in order to ensure sufficient offset prior to turning into the South Tower.

In order to avoid over-complicating the simulation exercise for the pilots, we did not give pilots instructions to initiate the last-second pull-out and instead focused on the execution of the final turn only.

Figure 5: NTSB Radar Data Impact Speed Study (NTSB, 2002c) shows the final radar returns for UA175. Red dots mark the starting point, and the black dots mark the approximate point after which pilots were asked to align with the South Tower.

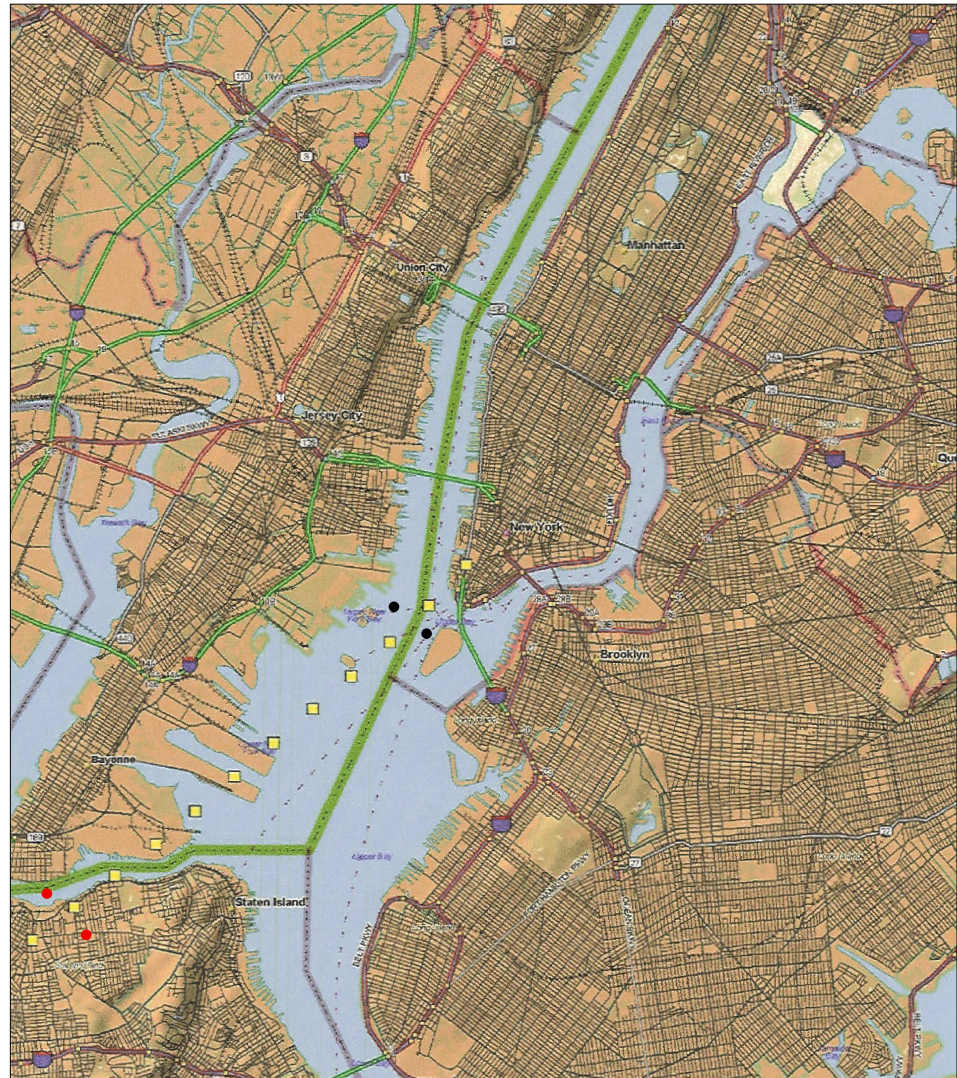


Figure 6: NTSB (2002c) report showing flight data determined from radar returns. The change in magnetic heading 10 seconds prior to impact reflects the turn the pilots were asked to replicate. Note: Examination of the magnetic headings in this report with NTSB (2002c) and visual analysis from films confirmed that NTSB (2002c) had derived the magnetic headings shown in the table from true headings but had done so incorrectly by subtracting rather than adding the necessary variation (circa 14 degrees West in 2001). These errors were corrected for both UA175 and AA11.

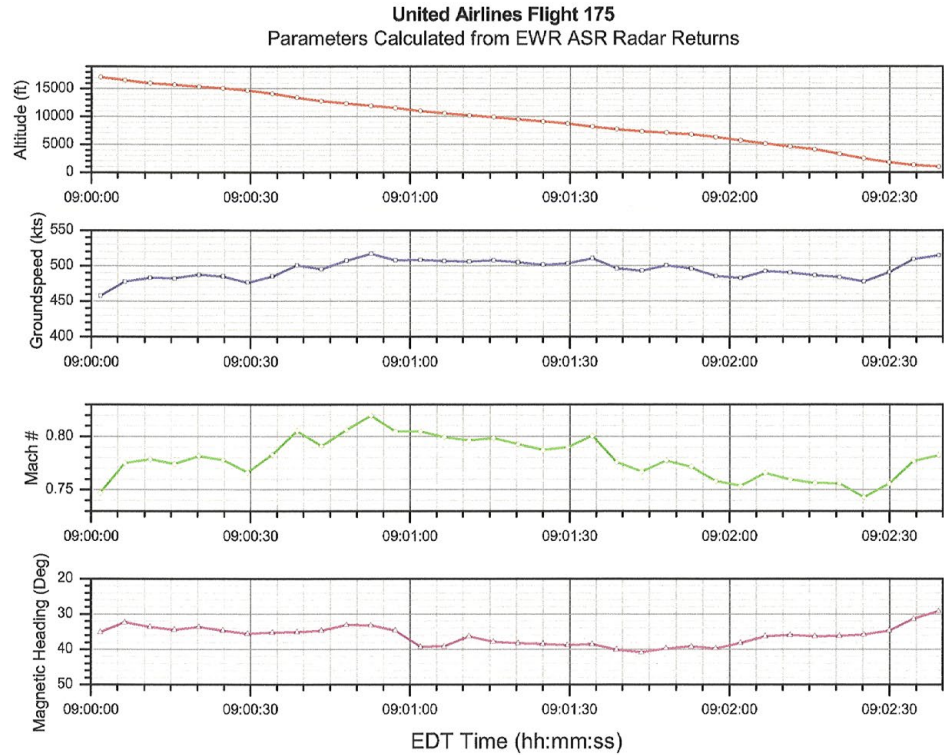
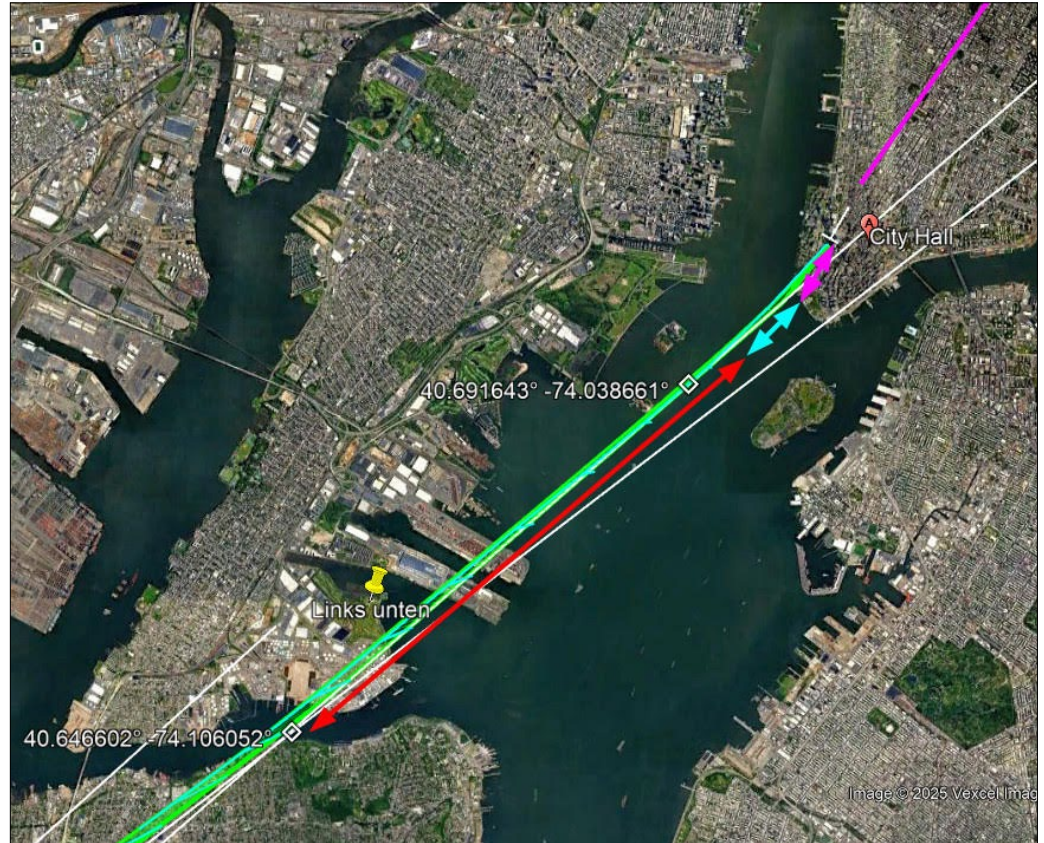


Figure 7: UA175 pulling out from a rapid dive while entering its final left-hand turn (BBC, 2001). (Click on image to view video.)



Figure 8: Estimation of turn derived from analysis of multiple films and the NTSB Radar Data Impact Speed Study (Kobs, 2025).

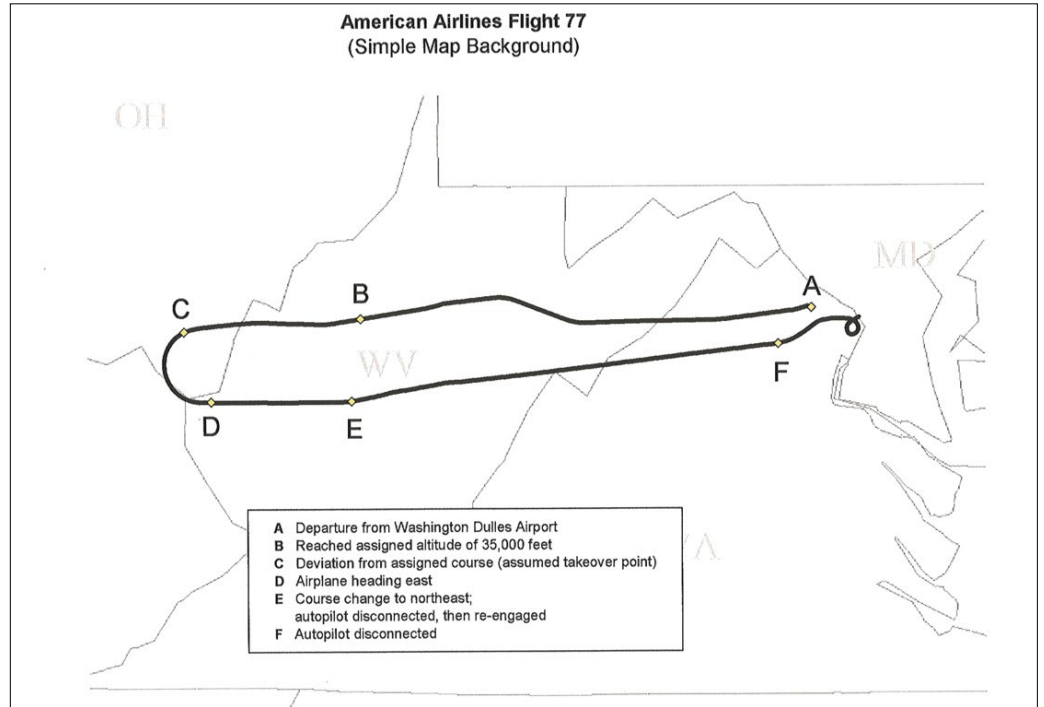


Pentagon

Prior to its final phase of flight and according to the NTSB Report (2002b), AA77 was hijacked at around 8:55 a.m. while at an altitude of 35,000 feet (see C in Figure 9 below) and then initiated a U-turn back toward Washington, D.C. For much of this time the autopilot was engaged. Then, at about 35 miles west of the Pentagon and at an altitude of 7,000 feet, likely beyond visual range of the Pentagon area, the autopilot was disengaged (see F in Figure 9 below).

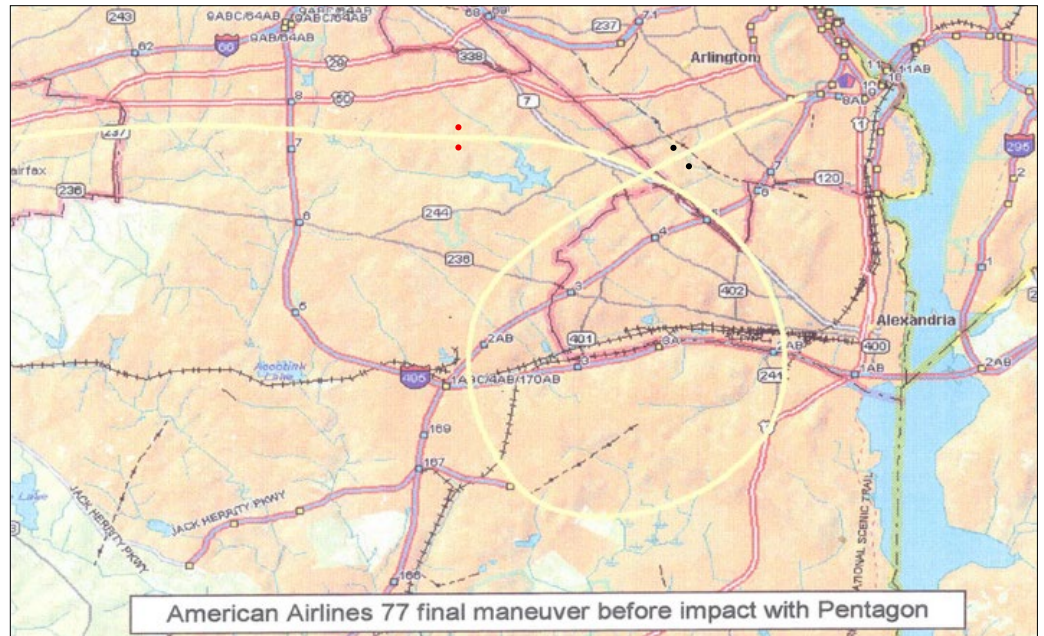
The aircraft did not then proceed directly toward the Pentagon but instead flew in a northeasterly direction for several minutes, before then turning to fly toward the Pentagon, and then, at about 10 miles west of the Pentagon, the aircraft started to turn to the right and away from the Pentagon again. After this, the final minutes of AA77's reported flight profile involved the 330-degree descending turn "orbit" and the final low-level run at the building. It was this final phase of flight that the indirect route simulator runs sought to replicate. Weather conditions were set to clear, as was the case on the day in question, while aircraft fuel and passenger loadings were also added.

Figure 9: Plan view of AA77's entire reported flight path taken from NTSB Flight Path Study – American Airlines Flight 77 (NTSB, 2002b).



The final phase of flight involved two distinct maneuvers. The first involved each pilot starting at the beginning of the descending turn — circa 7,500 feet above sea level and at 295 knots — and then orbiting through 330 degrees to before lining up with the Pentagon (see Figure 10 below). The second maneuver involved the pilots attempting to replicate the final approach and impact while flying at around 535 mph.

Figure 10: Plan view of AA77's reported flight path taken from NTSB Flight Path Study – American Airlines Flight 77 (NTSB, 2002b), with the red dots marking Starting Point 1 and the black dots marking Starting Point 2 (used if pilots failed to reacquire the Pentagon following the orbit maneuver).



In order to attempt to replicate the low pass over the lawn before impacting the Pentagon, the pilots were asked to attempt to clip the light poles on the highway in front of the building and then strike the Pentagon without hitting the ground (see Figures 11a&b, 12, and 13 below). For Stage 2, in order to help pilots avoid getting too low too soon, the instructions were refined to advise avoiding flying any lower than 2/3rds below the top of the Virginia Department of Transportation (VDOT) transmitter tower, which was located next to the Navy Annex (see Figure 11 below). In addition, rather than asking the pilots to focus on attempting to clip the light poles, they were instructed to use the light poles and ground floor of the Pentagon simply as guides in order to help achieve the low-level pass over the lawn.

In the event that a pilot did not manage to reacquire the Pentagon following the descending turn, a second starting point — at 2,500 feet above sea level and with a starting speed of 460 mph, approximately 30 seconds away from the target — was also established. This ensured that first attempt data for each pilot could be collected for both maneuvers (see Figure 10 above).

Figure 11a: Southeast view of AA77's final approach to the Pentagon based on 3-D modelling using FDR data (Kobs, 2025).

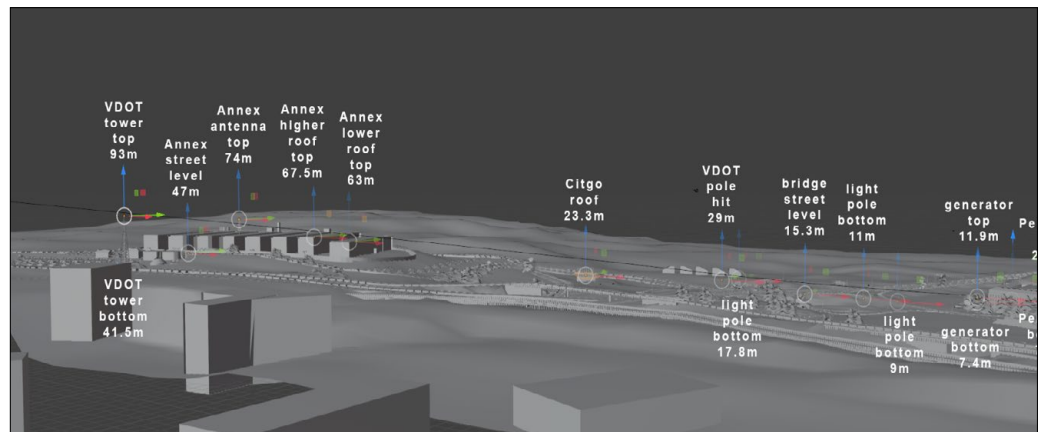


Figure 11b: 3-D modelling estimating possible path and height of AA77 at point of the VDOT transmitter tower and Navy Annex (Kobs, 2025).

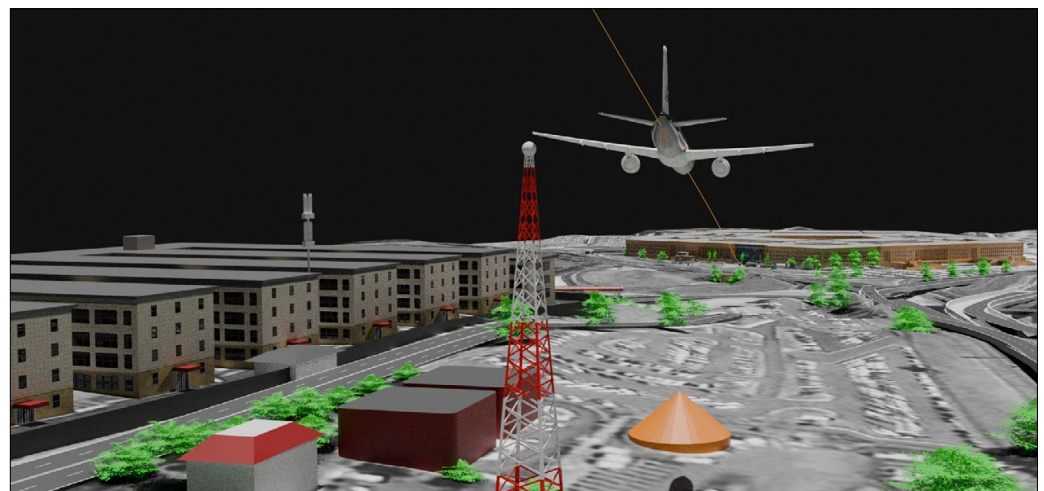


Figure 12: View of flight path from the Pentagon (Kobs, 2025).

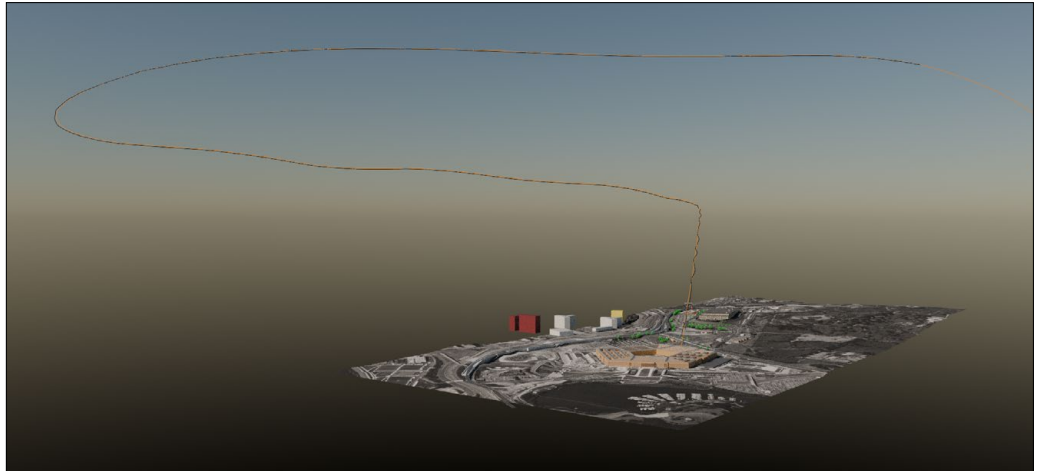


Figure 13: Security camera footage from one of two Pentagon security cameras shows the incoming plane flying nearly level, close to the ground, as it crosses the Pentagon lawn. The recovered flight data recorder indicates a very slight downward glide angle of -4° at this stage.



RESULTS FOR THE DIRECT ROUTES

Note: The table in Appendix 1 contains links to video clips of the simulations.

Table 1: Direct Route Results

	High-experience complete	High-experience incomplete	Low-experience complete	Low-experience incomplete	Combined high & low experience
South Tower	3	0	4	0	7 complete, 0 incompletes
Pentagon	1	0	3	1	4 complete, 1 incompletes

South Tower

All four low-experience pilots (Pilots 4 to 7) were able to line up with the South Tower at around the northern coastline of Staten Island and then fly reasonably controlled and straight paths into it. Three of the four pilots descended relatively quickly and aligned early on with the height of the towers, avoiding any steep final dive into the building (Pilots 4, 5, and 7). One of the pilots took longer to descend to the height of the tower but still flew in a fairly straight-line descent and avoided any form of dramatic last-second pull-out. Three of the four pilots were closely aligned with the South Tower — with bank angles below 10 degrees — and avoided any steep turn. One pilot, having lined up with the tower, deviated to the right at 20 seconds out and then corrected again with a left bank. All of the low-experience pilots reported that the South Tower direct route was easier to fly relative to the indirect route involving the last-second turn into the building.

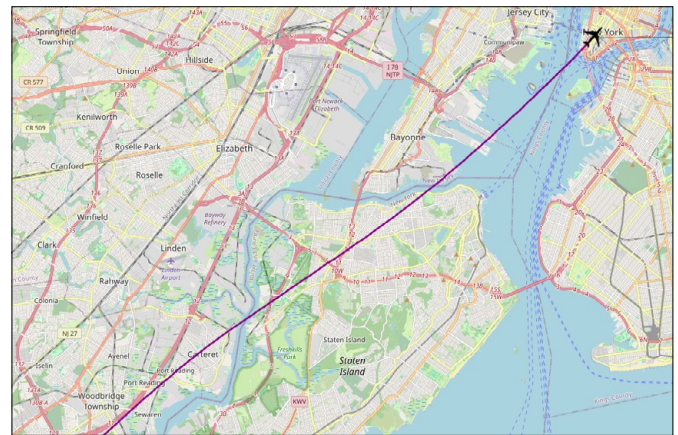
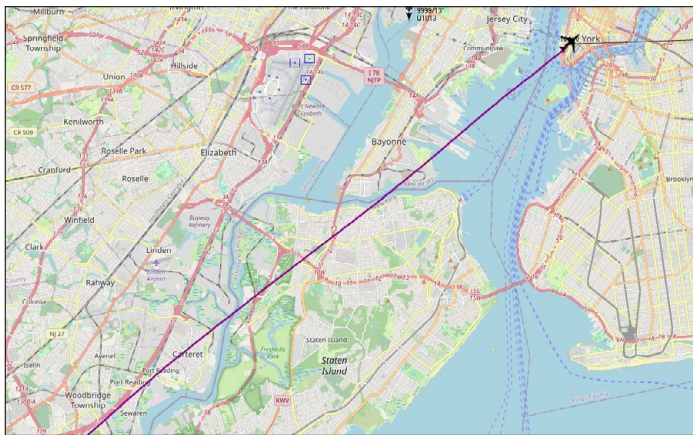


Figure 14: Ground tracks of the South Tower direct route for Pilots 4 and 5.

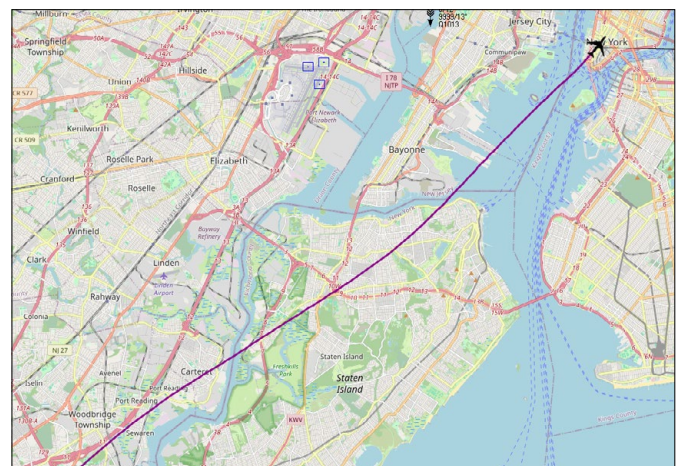
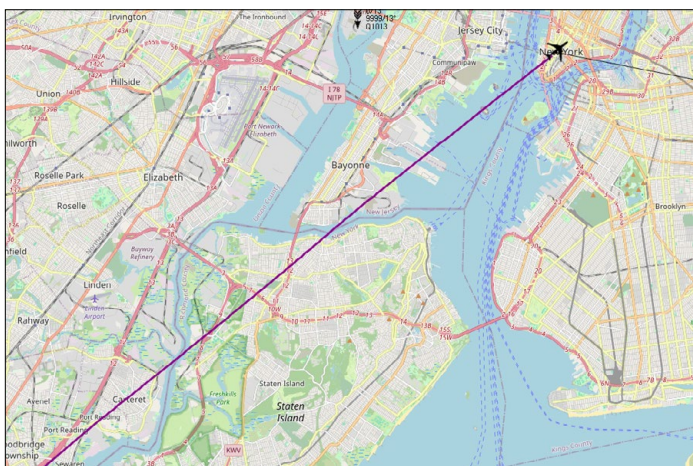


Figure 15: Ground tracks of the South Tower direct route for Pilots 6 and 7.

One high-experience pilot, Pilot 1, flew directly toward the South Tower on his first indirect route maneuver run and hit the tower with ease. Pilot 2, when on an indirect route maneuver re-run, lined up with the South Tower early and flew straight into it. On his final run in the simulator, which obviously followed multiple runs, and starting at the point of the alleged hijacking, Pilot 3 executed a long, smooth, and well-judged descending turn from around the Newark airport area and then lined up and impacted the South Tower via an angled approach (i.e., the aircraft's fuselage was not perpendicular to the face of the building). During this turn, initiated at 60 seconds out from the South Tower, adjustments were regularly made so as to bring the aircraft around onto its final track into the building.

Finally, two non-qualified individuals with no flying experience were able to fly the direct route at high speed, with minimal instruction, and hit the South Tower.

Illustrative quotes:

Pilot 2: "Actually in terms of straightforward going towards the Twin Towers, it would be fairly straightforward. . . . I would say, you know, people of various different abilities would actually be able to do that."

Pilot 5: "That was a lot easier. . . . You have high on the target. You concentrate on your altitude, on your glides and just hold it. Basically, aiming at a target. It's like there's a target out there and you are aiming this vehicle that you're in right at that and trying to basically get an angle of approach that went straight into that. Hit the target. And that was not that hard." (This comment relates to both the South Tower and Pentagon direct routes).

Pilot 6: "I found that easy. . . . So, it was a case of managing the altitude of the aircraft, maintaining approximately 500 knots to meet the target. So, I found that fairly straightforward."

Pilot 7: "It was a lot easier, natural, because I could see it, you know I knew which one the North Tower was and I could see the tower, and there quite a ways in the horizon but you could definitely see which one it was and I'm sure I hit that, review the tapes to make sure I'm not lying to you, I'm pretty sure I hit that much, a lot easier. It's like why not just fly right into the thing rather than trying to do this dog-leg over at the end there, so pretty sure I hit that one."

Pentagon

All four low-experience pilots (Pilots 4 to 7) were able to descend directly toward the Pentagon in a reasonably steady and controlled manner without a 330-degree orbit, with thrust settings still relatively high, and with the aircraft exceeding 400 mph. Three pilots hit the building, and one hit the ground just in front of it. In no cases was a 330-degree orbit needed to lose the necessary height. Pilot 6 maintained a relatively constant and angled approach throughout, and which demonstrated the ease with which the Pentagon could be hit without flying close to the ground. After following a relatively constant and angled approach, Pilots 4, 5, and 7 took a lower approach in the final phase, closer to the indirect routes that they had flown previously. This complicated their final approaches, leading to erratic control in the case of Pilots 5 and especially 7, and to Pilot 4 hitting the ground in front of the Pentagon. All of the low-experience pilots reported that the Pentagon direct route was generally easier relative to flying the Pentagon indirect route maneuvers (discussed below). One high-experience pilot (Pilot 3) flew a direct route and was able to comfortably descend the aircraft at a

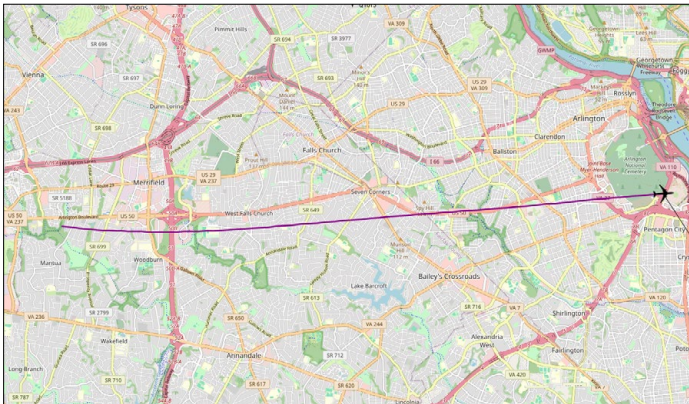


Figure 16: Ground tracks of the Pentagon direct route for Pilots 4 and 5.

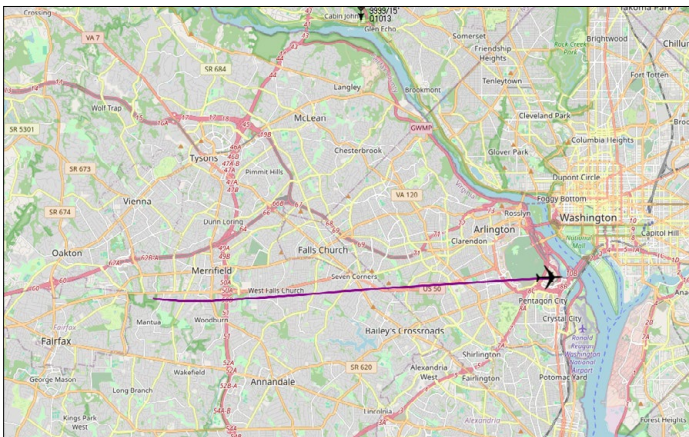
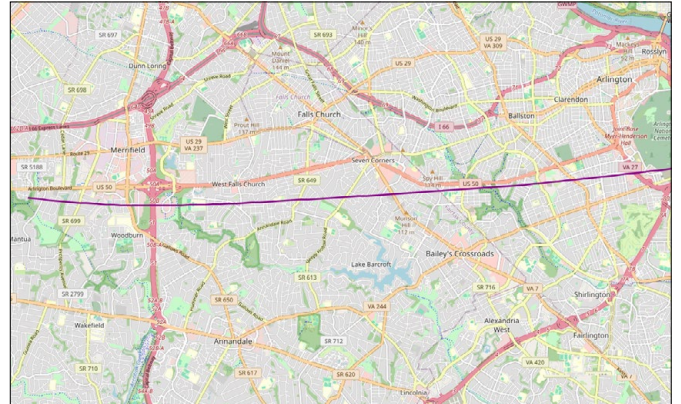


Figure 17: Ground tracks of the Pentagon direct route for Pilots 6 and 7.

constant angle, with no 330-degree orbit and again in overspeed conditions, to then impact the Pentagon.

Illustrative quotes:

Pilot 5: “You have high on the target. You concentrate on your altitude, on your glides and just hold it. Basically, aiming at a target. It’s like there’s a target out there and you are aiming this vehicle that you’re in right at that and trying to basically have an angle of approach that went straight into that. Hit the target. And that was not that hard.” (This comment relates to both the Pentagon and South Tower direct routes.)

Pilot 6: “The direct route for the Pentagon, I found straightforward. There was an obvious target. It was a case of maintaining the airspeed and the attitude of the aircraft to the target, which I found straightforward.”

Pilot 7: “. . . it was a lot easier. You start off at about 7,000 feet, . . . And then it’s a pretty, it’s a push down. No doubt about it. You’re descending fast. I mean, I was looking at the altimeter, it was descending pretty good. You’re dropping down. But as long as you’re not, as long as you just go right over to it . . . I think I hit it. I hit it.

In summary, when tasked with the objective of flying directly at the South Tower and the Pentagon, the low-experience pilots were able in all cases, bar one, to hit the buildings. In addition, two people with no flying experience were able to fly and hit the South Tower. In terms of the paths flown, all of the pilots lined up with the South Tower early on and, in three out of four cases, avoided the need for large altitude loss immediately prior to and during the last 10 seconds. In three out of four cases, pilots avoided any significant last-second banks. These findings provide clear evidence that hitting the South Tower could have been readily and intuitively accomplished without the need for last-second dives and pull-outs or banked turns. For the Pentagon, all four pilots were able to approach the Pentagon without any need for a 330-degree orbit to lose height, while Pilot 4’s approach demonstrated the ease with which a more angled approach, which avoided extremely low “skimming” of the ground, was readily available.

RESULTS FOR THE INDIRECT ROUTE MANEUVERS

Note: The table in Appendix 1 contains links to video clips of the simulations.

Limitations and Uncertainties

Examination of pilot performance during the indirect route maneuvers was challenging, and a number of uncertainties need to be identified. First, establishing the correct offset and determining the point at which to instruct the pilots to initiate the final turn into the South Tower were difficult to do with precision, and this would have impacted on how challenging each run was. The issue was also raised that the Boeing 737 simulator may be less maneuverable than a real-life Boeing 767 or 757, thus making the final turn (South Tower) and pull-out (Pentagon) more challenging than would have been the case in a real aircraft. The quality of the graphics might also have complicated control of the aircraft when attempting to hit the Pentagon. Finally, obtaining a balance between the instructions necessary to attempt a replication of the Pentagon profile while avoiding over-burdening the pilot was challenging. For example, the instruction to clip the light poles was seen as being too burdensome by one of the high-experience pilots. With these limitations in mind, it is possible that other studies, using different instructions and different simulated aircraft, may result in higher completion rates than observed for this study. The basic figures below should, therefore, be treated with caution. As we shall see, however, careful analysis of the simulator runs allows a number of substantive conclusions to be reached regarding the difficulty of these maneuvers.

South Tower

Table 2: Indirect Route Maneuvers
First Attempt South Tower Results

	High-experience complete	High-experience incomplete	Low-experience complete	Low-experience incomplete	Combined high & low experience
South Tower	0	2	0	3	5 incomplete, 0 completes

Assessing pilot performance during the South Tower runs was particularly challenging, and any variation in timing or angle of approach to the building would have affected the degree of difficulty faced during each particular run. Careful analysis, however, of all of the runs enables identification of what was challenging about this maneuver.

In terms of the raw results, none of the pilots completed the turn into the building on first attempt. Of the high-experience pilots, Pilot 3's first run was offset too much and prevented any chance of lining up with the tower. He did hit the South

Tower on this second run, but he initiated the turn-in before being instructed to and was already rolling the aircraft to the left. Pilot 3's first attempt was therefore coded as an *ambiguous* result. Pilot 5 (low-experience pilot) initiated his turn early and started to line up with the South Tower, but then mishandled the turn and missed: this was also coded as an *ambiguous* result. Pilot 1 lined up too early on his first run, and on his second run, which was counted as his first attempt, he missed the tower. Pilot 2 missed the tower on his first attempt. Among the other three low-experience pilots, none completed the turn maneuver into the South Tower on first attempt.

Key Challenges Identified

First, the roll angle of the aircraft affects the rate at which it turns. If the roll angle is insufficient, the aircraft will not turn fast enough to make the turn before the tower is reached. Pilots 1 and 2 started with relatively small roll angles that were probably insufficient for the needs of making the turn. Pilot 3, having already experienced handling the simulator in a high-bank attitude during his first run, rolled the aircraft more than Pilots 1 and 2.

Second, there was a tendency to apply inadequate back pressure during the



Figure 18: Examples from film showing Pilot 1's first attempt.

turn. This was most obvious with some of the low-experience pilots, and on two occasions with Pilot 6 the qualified flying instructor in the right seat noted that more back pressure would have enabled the turn into the tower to have been successfully completed, stating, "If you had pulled back you would have hit it."

Third, the time at which the aircraft started its turn toward the South Tower affected whether the maneuver was successfully completed. For example, Pilot 1's first attempt was called at about 9 seconds away from impact but there was then a delay of several seconds before he started to roll the aircraft: The result was that the aircraft was extremely close to the building before the aircraft started to turn. Pilot 3's second attempt, conversely, was initiated at 13 seconds out from the tower, which then provided more time to turn in toward the tower and align with it.

Fourth, an understanding of the roll angle and back pressure required to turn the aircraft in time to impact the building required knowledge of how the aircraft would perform. On first attempt, pilots necessarily had very little understanding of how quickly the aircraft would turn and, therefore, limited knowledge as to how much roll and back pressure would be needed as the aircraft rapidly closed in on the building.

These four challenges would have also been faced by the alleged hijackers when attempting the maneuver in real life.

Illustrative quotes:

Pilot 1: “The turn is actually more difficult than I thought it was. . . . I’m not used to flying at 500 kts (575 mph). 500 kts is pretty fast and so you don’t know what’s going to happen. . . . at 500 kts the turn radius is quite wide. . . . To do this turn that I mentioned, I’d do this turn and in fact I probably had 10 degrees to turn through and at 500 knots the turning circle is very wide. So, with that turn to do, I have to wind up crank on more or more bank and of course it doesn’t turn. So, I end up with a lot of bank on and probably just catching it rather than hitting it straight on.”

Pilot 2: “That was interesting. . . . not rolling as much as I want it to. . . . The roll rate is quite low. . . . It was a little bit difficult to refine and again getting used to the simulator and how it actually performed in terms of using the roll control.”

Pilot 3: “It’s a combination of things, not just the ground speed, but the closure rate for sure. The control fidelity that’s required at that speed. The aircraft is very sensitive to pitch changes. . . . The ailerons are a bit more sluggish than what I anticipated. . . . And . . . to pull it into target requires a tremendous amount of load factor if you’re off just by . . . a few degrees. And things are happening so fast that . . . there’s a process that goes on in your brain that . . . it’s just like any other skill. You’re calculating and controlling and . . . hoping that it’s going to work. And hope is not something that pilots train for. We train for practice. We train to achieve perfection. . . . I wasn’t familiar with the control inputs. . . . Even though I’ve flown thousands of other . . . airplanes or hours in other airplanes.

“ . . . having taught other pilots as an instructor, learning chandelles, lazy eights, eights on pylons, all the maneuvers that are required of a commercial pilot student takes repetition. There’s lots of repetition required to build the fundamental skill to pass a test in front of an examiner. . . . It’s not something that happens on the first go. . . . It’s something that must be exercised and a skill that must be developed in order to achieve that degree of difficulty. And yeah, I think it’s nearly impossible for somebody to go from an aircraft that they trained in that had cable controls, cables

and pulleys, to an aircraft that's fully hydraulic . . . with completely different control inputs and fidelity. That is just extremely unlikely.”

Pilot 6: “Maybe I wasn't being aggressive enough. . . . I was not familiar with the controls. . . . It's knowing what an aircraft can do in a high bank turn. . . . And then the turn in, I wasn't aggressive enough in the turn. And then subsequently I had two more attempts, which were a little bit more successful.

“I think the turn aspect and in terms of the first part was fine. The turn in, meeting the target was difficult because of the aircraft speed and the unfamiliarity that I had with the 737 simulator responses with the aircraft. Compared to an aircraft I would normally fly, I would be able to adapt the turn more sharply, understanding the limitations within that. So, I think it's the unfamiliarity for me with that aircraft's capability at that stage and the speed that we were flying at in the simulator that was difficult.

“But I personally feel that was more about the unfamiliarity of the aircraft's capabilities in the turn with the airspeed rather than anything else. I feel maybe having another few goes, I would be able to replicate the hitting the facade of the building more consistently. But obviously, in reality, what happened on that day was just a one-time show.”

Pilot 7: “It's a reaction time to wheel that thing in there. It's tight, not impossible, probably can be done. But it's not easy.”

Counter-Intuitiveness of Flying the Off-Set Maneuver

Further insights were gained during the simulation runs for the South Tower indicating that the indirect route maneuver was not an intuitive one for the pilots. For example, when instructed to fly the offset prior to being commanded to turn into the South Tower 10 seconds out, the pilots sometimes demonstrated a tendency to deviate from the offset and line up with the South Tower early. For example, on subsequent runs, Pilots 1 and 2 tended to line up early with the South Tower and, subsequently, fly the route with little or no offset. Pilot 3, on his second run, placed the aircraft in a bank early and called out the need to initiate the turn before being instructed to. Also, Pilot 5 initiated a 10-degree bank at 13 seconds from the South Tower and before being instructed to.

Discussing how he would have flown the route, Pilot 1 described how he would have flown a much more straightforward and controlled route into the building:

“If it was my decision, and I think that would be the decision of most qualified pilots . . . you'd plan your descent . . . so if you're coming down from let's say 30,000 feet normally, you'd plan about three miles per

thousand feet and still wind you'd add on 10 miles to slow down . . . so about 90 miles out still wind, just start down.

“You come down at a normal descent speed around 300 (345 mph), give or take, and you come down and a nice gentle descent, you wouldn't need any speed brake, it's there if you need it, and you just come down aiming straight at . . . your target. . . . If you couldn't see it from a distance, what I do is I'd pick a waypoint or a feature that's nearby that I can navigate to using the navigation system on the airplane. And in the case of New York, you have Newark very close by . . . what I would do initially is point at those to a nice descent of 300 knots (345 mph) and when I got visual with my target, which would be about within about five degrees one side of the other right in one case left in the other I just make the last final turn and just aim it and do it in a nice steady way probably even with the thrust lever still at idle . . . it'd be a very a very controlled maneuver. What they did in both cases was not a controlled maneuver.

“So, if you've been planning it and you've been a qualified pilot, what you'd have done is go down with about 100 miles to go. Have a nice 300 knot (345 mph) descent like you would, and just come down nicely and just aim straight at it and hit it absolutely square on . . .”

Pilots 4, 6, and 7 commented as follows on the illogicality of the off-set maneuver:

Pilot 4: “. . . there's no reason to if you knew the orientation of the buildings and you knew you wanted to go and hit the South Tower. Why would you wander off further to the south and then make the difficult turn. That's a very sharp turn at the speeds you're going here . . .”

Pilot 6: “The towers are so, or were so obvious, a landmark to not miss. So, I wouldn't understand why, from the perspective of just flying at a target, you would need to bear away. . . . I have no idea why you would head at one angle and then trying to make a sharp turn at the end. It's much, much more difficult, in my opinion.”

Pilot 7: “. . . it's like why not just fly right into the thing rather than trying to do this dog-leg over at the end there . . .”

In summary, completion of the South Tower indirect route maneuver requires precise timing to avoid the aircraft getting too close for the turn to be completed in time, as well as roll angle and back pressure that are sufficient to start the plane turning through the required number of degrees. At approximately 10 seconds from impact with the tower, the required control inputs need to be precise and decisive, and with knowledge of how the aircraft handles at the high speeds that were recorded. This knowledge would not be available to a pilot when first attempting the maneuver, whether in a simulator

or in real life. This result aligns with the assessment conducted by Aidan Monaghan (2026/2011), who determined that, at approximately 10 seconds prior to impact, the aircraft had to promptly initiate and then sustain a bank angle of 15–20 degrees to avoid missing the tower, and that this would have required a degree of precision inconsistent with manual control by the alleged hijackers. From a pilot’s perspective, the off-set route was also a counter-intuitive one.

Pentagon

Table 3: Indirect Route Maneuvers
Pentagon First Attempt Results

	High-experience complete	High-experience incomplete	Low-experience complete	Low-experience incomplete	Combined high & low experience
Pentagon	0	3	0	4	7 incomplete, 0 completes

On first attempt, none of the pilots, whether of high- or low-experience, completed the combined indirect route Pentagon maneuvers. While two of the high-experience pilots (Pilots 1 and 2) and two of the low-experience pilots (Pilots 6 and 7) successfully reacquired the Pentagon after the descending 330-degree turn orbit, they did not then achieve the low pass over the lawn into the building: Pilot 1 ended up flying just over the top of the Pentagon; Pilot 2 hit the Pentagon but high up; and Pilot 6 hit the ground in front of it. Pilot 7 did reacquire the Pentagon but then continued turning to the right. On his second run he did not reacquire the Pentagon. One high-experience pilot, Pilot 3, and two low-experience pilots, Pilots 4 and 5, did not reacquire the Pentagon after the descending 330-degree turn.

The re-runs by the high-experience pilots following the first attempts highlight the difficulty involved in completing these maneuvers. Pilot 1, after having successfully reacquired the Pentagon on his first run, found it very late on his second run and was then unable to line up with the building. Across four subsequent runs, Pilot 1 did not complete the combined Pentagon maneuver. Pilot 2 completed the combined maneuver on his fourth and sixth runs but did not do so on his third and fifth. Pilot 3 completed the combined maneuver on his third and fifth runs but did not do so on his fourth and sixth.

If we include all of the first attempts and re-runs by both high-experience and low-experience pilots, some starting from Starting Point 1 and some starting at Starting Point 2 about 30 seconds out, there were a total of 25 runs involving an attempt to replicate the low-level flight maneuver into the Pentagon. Of these, only seven achieved the low-level flight into the side of the Pentagon — a 28 percent completion rate — and none of these were on the first attempt. Furthermore, only four of these completed final maneuvers into the Pentagon followed a successful completion of the descending turn orbit, for which there

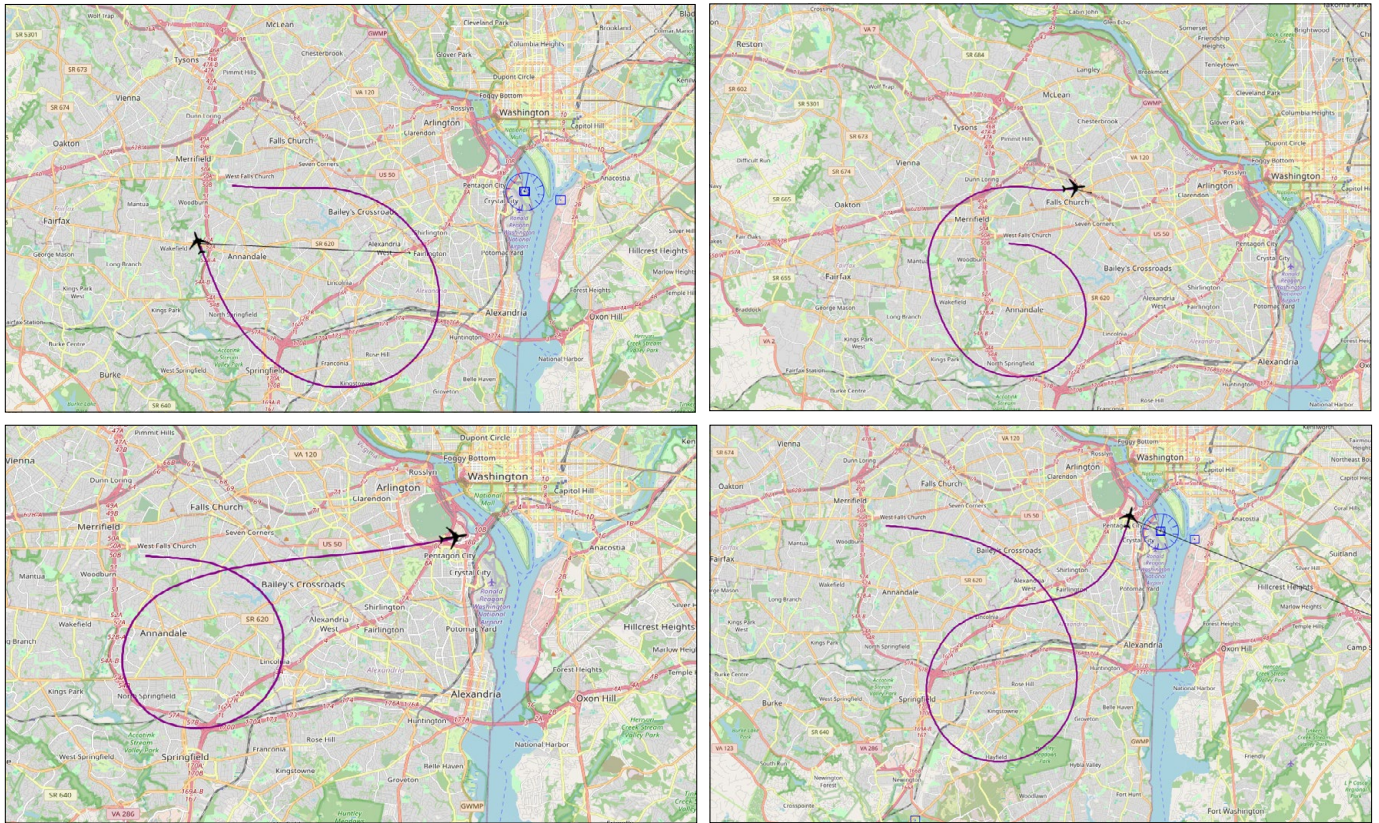


Figure 19: Ground tracks of first attempt runs for Pilots 4 (top left), 5 (top right), 6 (bottom left), and 7 (bottom right).

was a total of 22 runs — meaning a completion rate of just 18 percent when starting from Starting Point 1, with all completions coming only on re-runs.

Key Challenges Identified

A principal challenge for several of the pilots during the descending turn was to accurately identify the Pentagon after having turned away from the building and having no visual contact with it for an extended period of time. Difficulties were exacerbated if the aircraft was allowed to descend too low, which then limited the ability to see far enough into the distance.

Illustrative quotes:

Pilot 1: “Well, the Pentagon is the most difficult one because you have to pick it up visually, first of all. . . . I think the biggest problem in the Pentagon is because they threw this orbit and we’re replicating the orbit is picking it up visually, actually seeing it. And you think it’s a huge freestanding building. I think it’s probably the biggest in the world or the second biggest, I don’t know. But trying to pick it up visually coming out of the turn . . . I came out the turn probably a little bit too low. And when you’re really low down, trying to pick it up was quite difficult.”

Pilot 3: “The Pentagon was a challenge as well. It was a right 270-degree turn. And in order to fly the profile . . . when you make a 45-degree bank, you lose visual with where you’re at. The Pentagon and the landmarks disappear above the windscreen. . . . You’re steep and . . . it’s hard to maintain situational awareness.”

Pilot 4: “The other issue was where do you come out of the turn because if you’re late . . . if you haven’t dropped down to somewhere around four or five or four thousand feet, you’re never going to get it to the ground on to hit the Pentagon . . .”

Pilot 6: “At the Pentagon, I managed to pull it off, but I think it was more luck than anything else. I had inadvertently not checked my direction indication on the gyro compass, which would have just given me a 360, and that I could have managed. Maybe not any better than not doing that, but I think it was just luck that I ended up pulling out and recognizing the target.”

With respect to the low pass across the lawn in front of the Pentagon, the observable problems with flying this maneuver stemmed from the challenge involved in judging the pull-out so that the aircraft became low and level with the ground as it flew toward the Pentagon while simultaneously avoiding hitting the ground.

The high-experience pilots, instructed to try and clip the light poles in front of the Pentagon, tended to fly an extremely low approach, sometimes “hugging the ground,” but did not approximate the low pass across the lawn on first attempt. Here, for example, too much control input — pulling back too much on the control column — could result in the aircraft ballooning or getting too high. The low-experience pilots, instructed to keep the height up on approach through visual reference to the VDOT tower, tended to impact the ground just short of the Pentagon on first attempt. Here, for example, too steep an approach angle and too little control input — not pulling back on the control column enough — led to the aircraft hitting the ground just short of the Pentagon. As noted above, **out of 25 attempts to replicate the Pentagon maneuver (including first attempts and re-runs and from either starting point), only seven ended with low passes across the lawn and flight into the lower part of the Pentagon facade, and none of these were on first attempt.**

Controlled completion of this last-second maneuver would likely have required knowledge of the exact amount of control input needed in order to simultaneously avoid hitting the ground while still hitting the building low down. This knowledge would not have been available to the alleged hijacker on a first attempt and at speeds well in excess of the normal operating envelope of the aircraft.



Figure 20: Examples from film showing Pilot 3 skimming roof of Pentagon on first attempt.

Illustrative quotes:

Pilot 1: “Trying to hit it and do exactly what they did and replicate their scenario and fly at the sort of heights and speeds that they did is quite difficult because it enters a different realm and you’re trying to replicate something that isn’t natural to oneself. . . . That was the biggest problem, picking up the Pentagon visually, and then trying to fly at the height . . . and from then on, they literally just pointed at the ground, realizing they were high and fast. . . . And again, they were diving down quite steeply. There’s a ridge not far in front of the Pentagon, and they went over that ridge really close. They hit a building and then dropped down. And I think they were going down so quickly. They literally went, ‘We’re going to hit the ground in front of it.’ And they did a real ‘yug,’ like you would, and pulled back on the stick. They just happened to arrest the rate of descent down to about 10 feet and got lucky. Those guys just got incredibly lucky and they achieved the objective, I think, more by luck than judgment. And that was a much more difficult target than the World Trade Center, in my opinion.”

Pilot 2: “It would be a challenge, I would suggest, certainly for those maybe not quite as experienced or have not got many flying hours behind them, especially on big jets . . .” (This comment refers to the combined Pentagon maneuver.)

Pilot 3 (see also flight transcript regarding sensitivity in pitch): “I was tasked with increasing throttle . . . which made it more difficult.”

Pilot 4: “So it’s I think finding the place where you wanted to in the building on the ground when you’re traveling at three to five hundred miles an hour trying to hit it, that takes some skill and I think that was really, really the hard part.”

Pilot 5: “I didn’t hit the first floor. I probably hit the top floor. But at least acquired the building and was able to hit it. I have no doubt that Hani Hanjour could [not] have done that . . . other than [through] dumb luck.”

Pilot 6: “Pretty tricky, pretty tricky. . . . You’re shoving the thing down because I knew I wanted to be low, because I went in on the first floor there. . . . I knew I wanted to be as low as I could, but I didn’t want to be too low. And so, fiddling with the thing, making adjustments like I would on a small plane. And, of course, it doesn’t react quickly. So, I don’t know, it’s just a little, it’s a little tricky I think. It’s not that easy to just smoothly go down, go and have everything coordinated just to and then pull-out and then go into the thing. It sounds easier than it is. You would think, well, what’s the big deal? But it’s just tricky. You get little humps and bumps that you got to compensate. And you got to be careful you don’t overcompensate too.”

Counter-Intuitiveness of Flying the Pentagon Indirect Route Maneuvers

Regarding the Pentagon route, Pilot 1 described how he would have carried out the maneuver:

“They got much, much faster than you would do. I’d probably do it again somewhere between 250 and 300 knots (287-345 mph). They end up again at 500 (575 mph), much faster than I’d aim to, because it makes the airplane much more difficult to fly. . . . It might have broken apart. We don’t know that. It didn’t, but it might have done. So why risk it? Why not just fly? Just at the top end of the flight envelope, rather than flying 200 knots outside the flight envelope.

“You come down at a normal descent speed around 300 (345 mph), give or take, and you come down and a nice gentle descent, you wouldn’t need any speed brake, it’s there if you need it, and you just come down aiming straight at . . . So, you probably, if you couldn’t see it from a distance, for me, what I do is I’d pick a waypoint or a feature that’s nearby that I can navigate to using the navigation system on the airplane. . . . In the case of the Pentagon you have Washington National and there and that’s what I would do initially is point at those to a nice descent of 300 knots (345 mph). And when I got visual with my target, which would be about within about five degrees one side of the other right in one case left in the other, I just make the last final turn and just aim it and do it in a nice steady way probably even with the thrust lever still at idle if I got it right and if necessary put power on at the last moment.”

Pilot 3 also commented on the counter-intuitiveness of the high speed and throttle setting:

“But it is counter-intuitive to throttle forward as you are coming out of the dive because you can’t see. . . . It was intuitive that I wanted to throttle back . . . to slow down, to make things happen slowly, but that’s not what we were told happened. . . . You know, I was tasked with increasing throttle . . . which made it more difficult.”

Pilot 6 commented:

“I think, in terms of the target of the Pentagon, flying at the target, if you were wanting to just hit the target with the maximum impact you could have, I wouldn’t be looking at any particular facade of the building. I would be looking at the building.”

Similarly, Pilot 7 noted:

“So . . . once again, it’s like, why not just do that? Why not just go right into it? . . .]Why would you do a relatively complicated horizontal spiral turn plus maintaining]altitude? Why not just crash into it?”

In summary, the successful controlled completion of the combined Pentagon maneuvers required, first of all, close attention to aircraft heading to help assess when the 330-degree turn orbit was likely to be completed, careful management of descent rate to prevent the aircraft from descending too low and losing the ability to see far enough to actually reacquire the Pentagon, and then rapid identification of the Pentagon building from amongst the clutter of other buildings in the area. Then, once aligned with the Pentagon, precise handling via a well-judged descent path and exact control inputs to bring the aircraft out of the descent and into a low and flat orientation extremely close to the ground a second or so before impact would have been required. The knowledge needed to successfully execute the final approach and last-second pull-out while handling the aircraft at very high speed would not have been available to a pilot on first attempt. Similar to the South Tower indirect route maneuver, from a pilot’s perspective, the Pentagon maneuvers were counter-intuitive ones.

ANALYSIS OF FLIGHT PATHS AND FINAL TRACKS INTO BUILDINGS

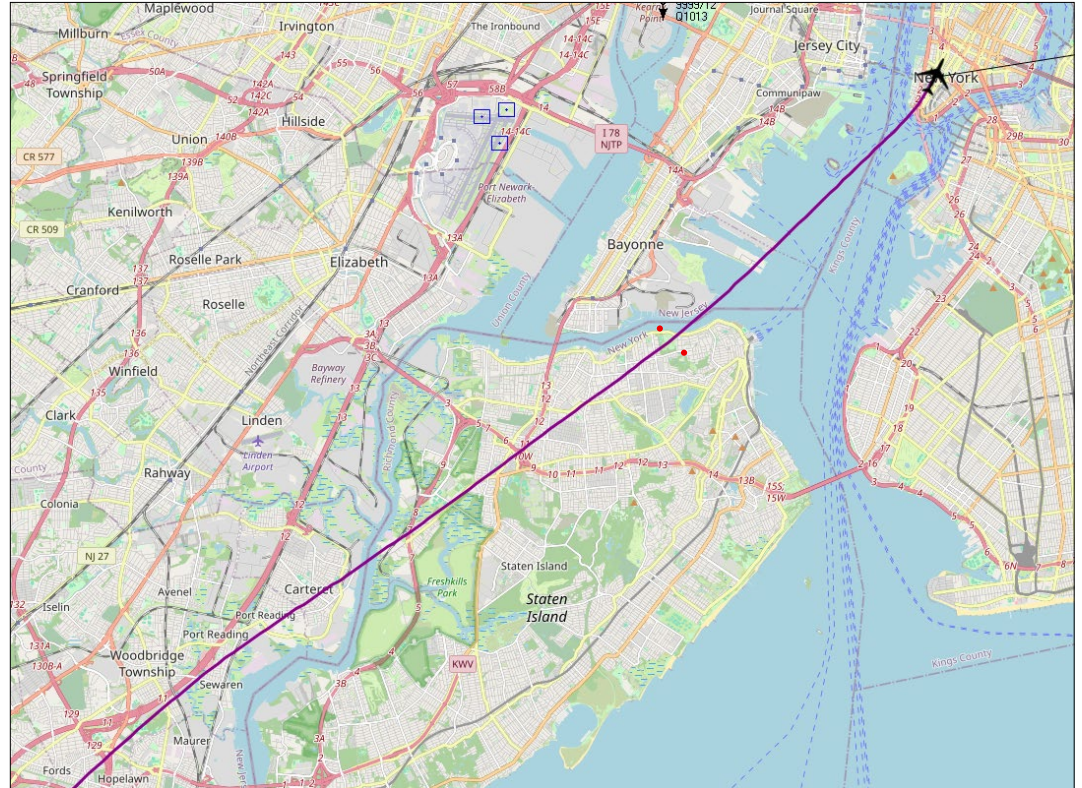
Analysis was conducted to map the flight routes of the aircraft that struck the South Tower and North Tower. Based upon the NTSB-provided headings (2002c), the actual routes flown by UA175 and AA11 were mapped and then replicated in the simulator by the Research Director.

Figure 21 below shows the reported track for UA175 as it flew over Staten Island and then approached the South Tower. A series of turns are made — first one to the right and then two to the left — culminating in the final turn into the South Tower. Figure 22 below shows the ground track from the Research Director’s demonstration of the UA175 route.

Figure 21: Estimation of UA175 route derived from analysis of multiple films and the NTSB Radar Data Impact Speed Study. White lines indicate headings flown at different parts of the route (Kobs, 2025).



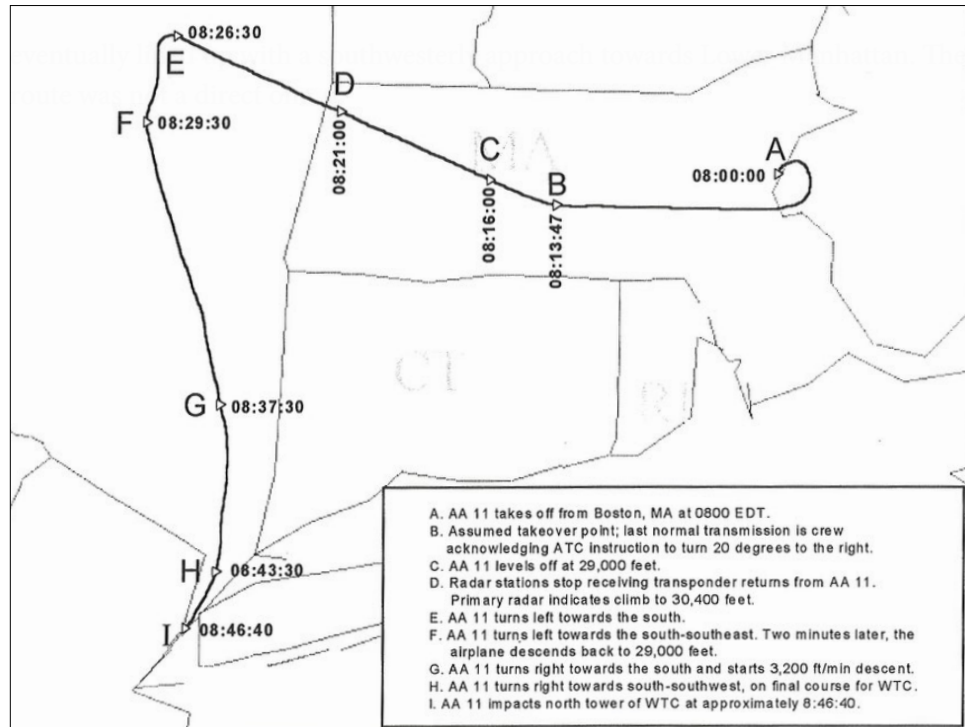
Figure 22: Ground track from demonstration of UA175 route. See video clips [here](#) and [here](#).



The Research Director’s demonstration of the UA175 route showed that flying this route involved flying headings that were not aligned with the obvious optimal route to the South Tower. While flying over Staten Island, this artificial offset was not particularly noticeable as the aircraft was still heading toward Lower Manhattan. However, after crossing the coastline (see red dots in Figure 22 above), flying the offset became increasingly counter-intuitive as it became more and more obvious, when closing in on Lower Manhattan, that the offset would miss the South Tower.

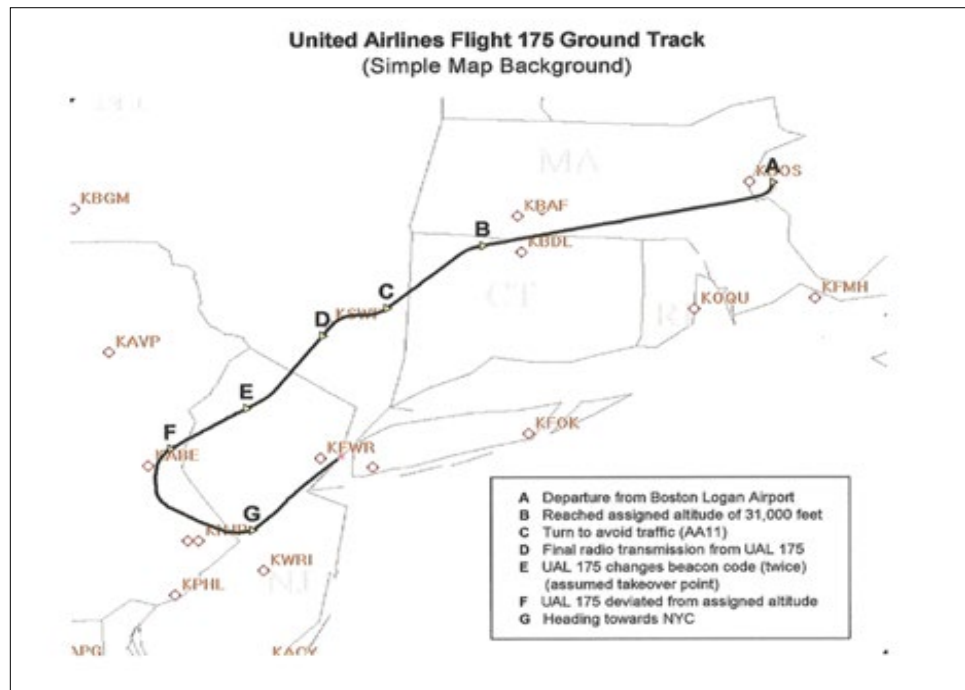
Figure 23 below shows the reported ground track of AA11. After the point of the takeover (see point B in Figure 23 below) the aircraft continued on course for close to 13 minutes before turning onto a number of southerly headings that

Figure 23: NTSB (2002d) Flight Path Study for AA11.



If we compare AA11’s indirect flight path with UA175’s indirect flight path (see Figure 24 below), we can see that both involved turns and maneuvers that eventually set each aircraft up for their final perpendicular tracks (to be discussed shortly).

Figure 24: NTSB Flight Path Study (NTSB, 2002a) ground track of UA175’s complete flight path.



The final approach for AA11 involved three small turns in the final minute before impact with the North Tower (see Figure 26 below). The final turn, at the far left of the track below, shows AA11 aligning with the North Tower in the final seconds with a small turn to the left. The end of the solid purple line represents the last data point from the NTSB radar track and the dotted line shows the final seconds as the aircraft lines up with a track perpendicular to the face of the building. The 20- to 25-degree roll to the left, necessary to bank the aircraft in the final seconds, is also indicated by the impact damage on the facade of the North Tower, which shows the aircraft rolled to the left (see Figure 27 below).

Although there were asymmetries between the two flights — different impact speeds and heights — there were also important symmetries. Similarly to UA175, AA11 descended approximately 500 feet during the final 10 seconds of flight and at rates from 3,500 fpm to around 900 fpm as it pulled out of the dive, impacting the North Tower at between 1,150 and 1,160 feet (see Figure 25 below), while also turning and achieving its final completely perpendicular flight track — to within less than 1 degree, per the National Institute of Standards and Technology (NIST) — and impacting the center-most column of the north face. The fact that AA11 struck the center-most column of the north face with the fuselage at an absolutely perpendicular angle to the north face, immediately following a last-second turn and rapid descent and pull-out, is by itself strongly suggestive of automated control.

Figure 25: Estimation of vertical speed rate of descent changes during the last 15 seconds of flight (Kobs, 2026). Derived from analysis of NTSB Radar Data Impact Speed Study (2002c).



Figure 26: Estimation of AA11 route derived from analysis of film and the NTSB Radar Data Impact Speed Study. White lines indicate headings flown at different parts of the route (Kobs, 2025).

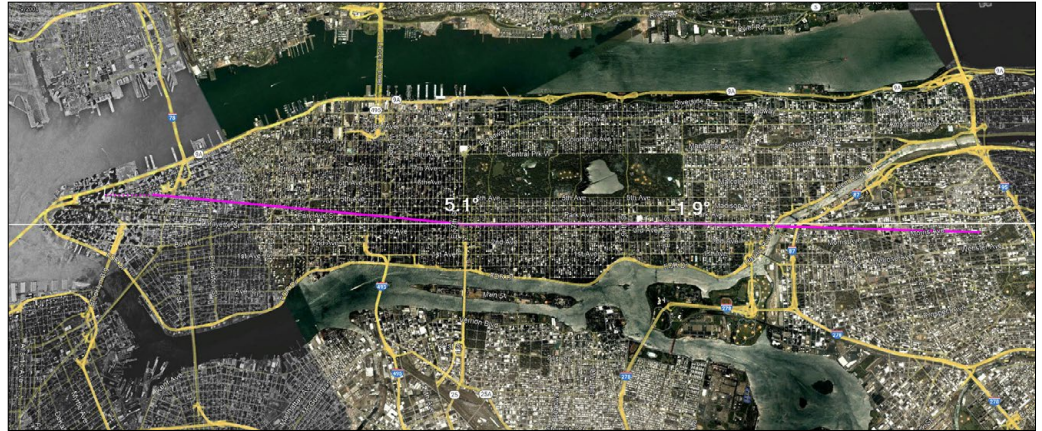


Figure 27: AA11 impact with North Tower showing roll to the left (NIST, 2005).

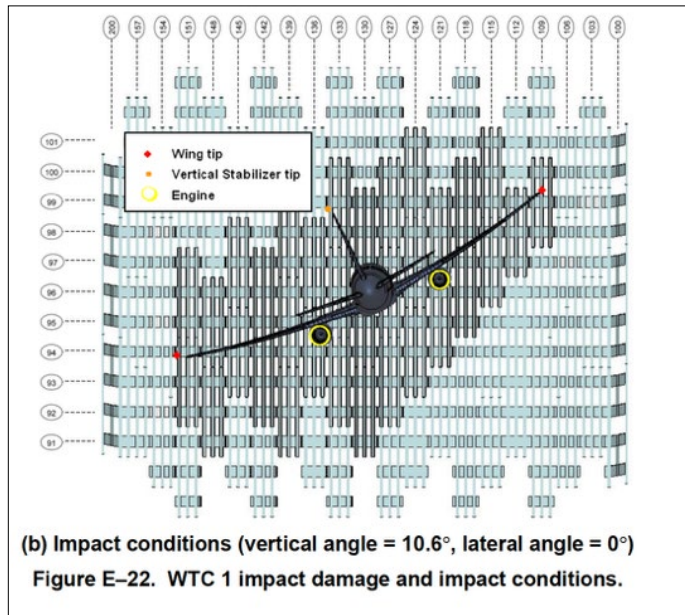
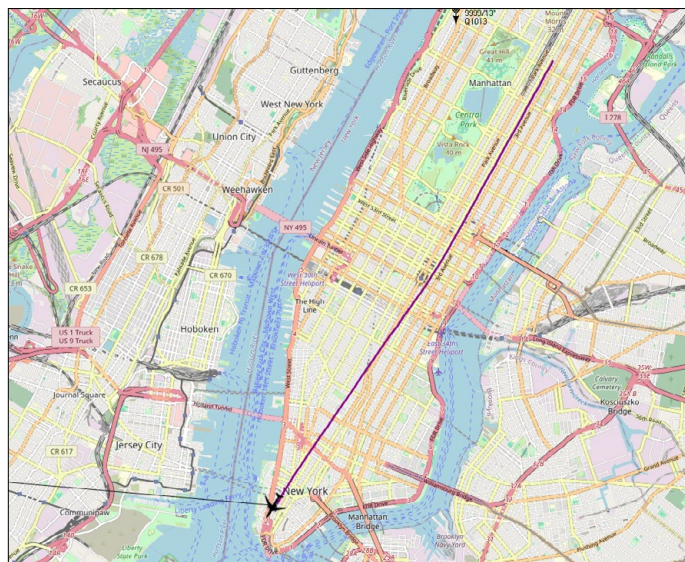


Figure 28: Demonstration of AA11 North Tower route. (Please note that the final offset and last-second turn was not attempted for these demonstrations.) See video clips [here](#) and [here](#).

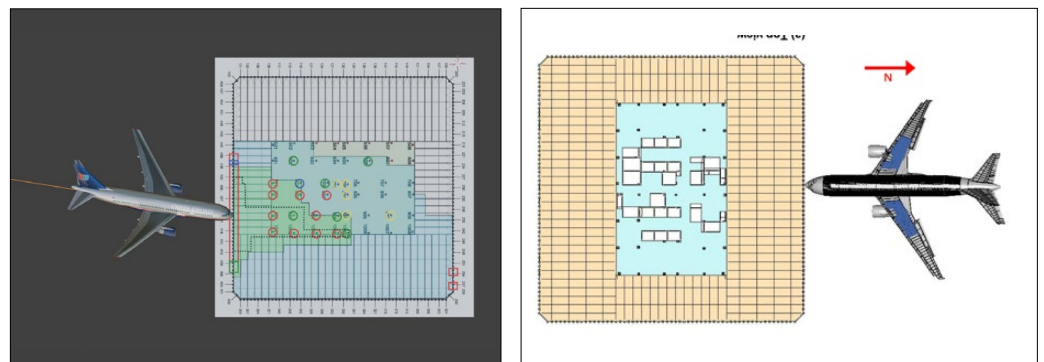


Indeed, in both cases, the turns made in the final minute or so and in the final seconds resulted in the aircraft impacting perpendicular to the face of each building. The first of the images below show the tracks in yellow that are approximately perpendicular to the north and south faces of both towers. The turns seen in the flight tracks brought the reported paths of both UA175 (in green) and AA11 (in red) into close alignment with these perpendicular tracks (see Figures 29 and 30). The probability of both AA11 and UA175 exhibiting such symmetry under manual control is extremely low.

Figure 29: Estimation of reported flight tracks using Google Earth (with UA175 in green and AA11 in red). Yellow lines show approximation of tracks running perpendicular to the building faces.



Figure 30: Images showing South Tower (left) and North Tower (right) impacts. The left image is from 3-D modeling of UA175's 8-degree impact angle (Kobs, 2026). This modeling improves in accuracy compared to the NIST report, which showed a 15-degree angle relative to the South face. The right image showing AA11's impact angle is from the NIST report (2005). This shows an impact angle of 0 degrees to the north face, i.e., perfectly perpendicular.



Guiding the aircraft so that they line up to impact in the center of and perpendicular to the faces of the buildings would minimize the risk of either missing the building or striking a corner. If either tower had been struck at an angle or near a corner, it is difficult to predict how much of the aircraft would penetrate the building and how much of it would be deflected.

Referring again to Figures 21, 26, and 29 above, the flight paths show a series of small turns that function to bring the aircraft into alignment, eventually, with a perpendicular track into each tower. These changes are subtle and incremental, thus avoiding larger heading changes that may be suspicious and more likely to give away the apparent objective of lining up perpendicular to the towers. They also avoided lining up so far out from the building that the perpendicular alignment would have looked intentional and impossibly precise for someone manually flying the aircraft. In addition, the last-second pull-outs, which were not necessary to impact the building, would be consistent with the need to have the aircraft impacting at a specific height of the building. Also, the last-second turns and pull-outs, when the aircraft are finally pulled toward alignment with the perpendicular track and toward a particular height on the building, would have served to make the flight look somewhat uncontrolled, consistent with the official narrative that relatively inexperienced pilots were flying. It is also plausible that the last-second banks and pull-outs were a function of a terminal guidance system that was tasked with the final precise targeting of the building and that “kicked in” during the final seconds.

Regarding the Pentagon, aligning the aircraft with a relatively horizontal path that takes the aircraft into the side of the building would seem to minimize the possibility of it striking the building roof and causing damage to the other wings of the Pentagon. If the aircraft had approached at a steeper angle, it becomes possible for the aircraft to impact the roof area.

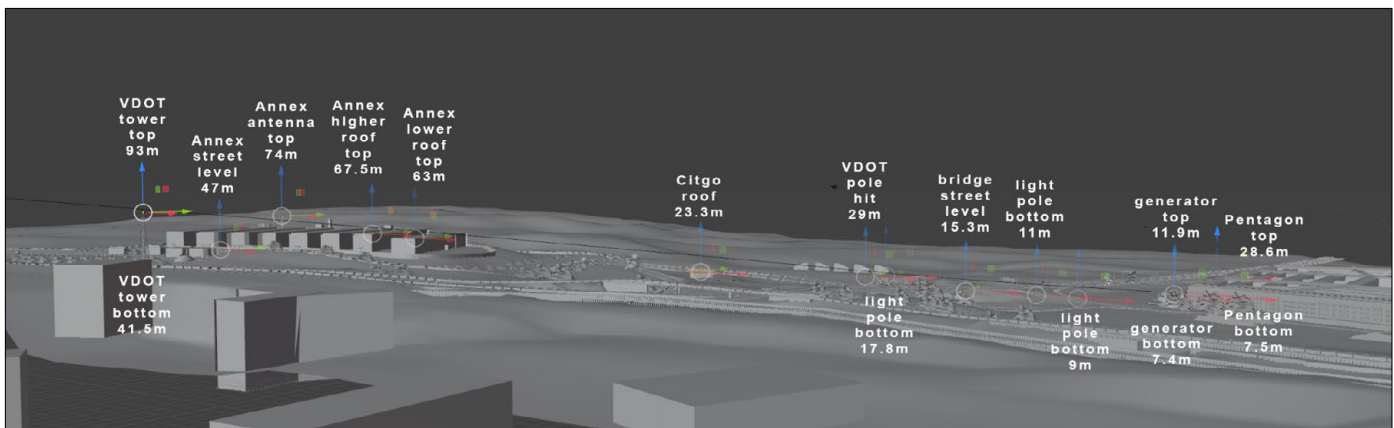


Figure 31: Side view of AA77’s reported final approach to the Pentagon based on 3-D modelling using FDR data (Kobs, 2025).

In summary, analysis of the final paths flown by UA175, AA11, and AA77 indicates precise and deliberate maneuvering of the aircraft to achieve specific approach angles and points of impact.

SYNTHESIS OF FINDINGS AND DISCUSSION OF MANUAL VERSUS AUTOMATED CONTROL

The findings and conclusions of this study are as follows:

1. Hitting the Twin Towers and the Pentagon under manual control and at high speed would not have been inherently difficult. Direct and readily accomplishable routes were available for the aircraft that reportedly struck these buildings and these routes had high completion rates in this study. In all three cases, the aircraft could have been flown in straight lines toward the intended targets. These “direct routes” could have avoided the demanding maneuvers that the three aircraft reportedly performed in the final minutes and seconds of flight.
2. Although direct and readily accomplishable routes were available, the reported flight paths were indirect. From the point of reported takeover, each flight followed routes involving multiple legs during which the aircraft was not flying directly toward the target. When nearing the target, during the final minutes and seconds of the actual reported flight paths, the aircraft performed unnecessarily demanding and counter-intuitive maneuvers that were illogical from a piloting perspective. In the case of the routes into the Twin Towers, these maneuvers included, within approximately 10 seconds of hitting each tower, pull-outs from rapid descents coupled with sharp banked turns necessary to align with the towers. In the case of the reported route into the Pentagon, the maneuvers included a 330-degree descending turn orbit followed by an extremely low pull-out to fly level across the ground just in front of the Pentagon.
3. These final maneuvers were inherently difficult, though not impossible, to successfully execute. The completion of them required precision flying that also likely necessitated prior knowledge of how the aircraft handled at high speed. On first attempt, by definition, the alleged hijackers could not have possessed this knowledge. The maneuvers involved in both of the indirect routes had low completion rates in this study. If the maneuvers had been

manually flown, one would reasonably expect the pilots to fail to complete these maneuvers at first attempt.

4. The reported final flight paths for all three aircraft are consistent with deliberate and precise targeting. Both of the aircraft that hit the Twin Towers were maneuvered in the final seconds so as to achieve a completely or nearly perpendicular path into the face of each building, impacting at or near the center. Moreover, the earlier phases of these flights, after the reported point of takeover, involved a series of maneuvers that brought the aircraft into a position from which the final perpendicular tracks could be flown. Meanwhile, the final track of the aircraft that hit the Pentagon involved an extremely low final approach, nearly level with the ground, so that the aircraft impacted the building from the side at ground level.

Taken together, these findings do not support the manual control hypothesis.

In a scenario involving manual control, one would expect to observe the following:

- The hijacked aircraft would have been flown as quickly and directly as possible toward the buildings, effectively “making a beeline” to the target.
- The alleged hijackers would have avoided unnecessarily demanding final maneuvers that required precision flying under conditions in which the handling of the aircraft was unknown. In particular, it is difficult to imagine a plausible scenario where a pilot would remain offset until 10 seconds before hitting the target. It is also difficult to envision a scenario where a pilot would not descend to the height of building until within seconds of impact and would perform a last-second pull-out while also turning into the building. The high speeds, approach angles, and steep descents and pull-outs involved with both the Twin Towers and the Pentagon routes are counter-intuitive from a piloting perspective. As seen in South Tower direct route flown for this study, the pilots instinctively lined up with the tower early on and, in three out of four cases, avoided both the last-second dive through 800 feet and subsequent pull-out as well as significant last-second banks.
- When attempting these maneuvers — one involving a 15- to 20-degree banked turn at 575 mph just 10 seconds out from the South Tower combined with an 800 foot descent, another involving a similarly banked final turn and rapid descent for the North Tower, and another involving both a 330-degree orbit and recovery from a rapid descent so as to then fly level, just above the ground, and hit the Pentagon also at around 535 mph — one would reasonably expect a high rate of failure.
- With respect to the final tracks of the aircraft that struck the Twin Towers, one would expect there to be a much greater degree of difference, with each aircraft approaching at different angles and a constant rate of descent, as

opposed to both achieving near perpendicular tracks following last-second banked turns and rapid descents followed by pull-outs. With respect to the aircraft that struck the Pentagon, one would expect a manually flown plane to have avoided a 330-degree orbit and descended toward the building at a steeper angle, avoiding the risk of hitting the ground and ensuring a larger visual target to aim for, and to have then impacted the building anywhere between its side and its roof.

Conversely, the findings do fit well with the automated control hypothesis, whereby the aircraft were controlled so as to fly specific routes and final maneuvers in order to achieve particular impact angles and points of impact. The final maneuvers involved a level of precision and judgment that is consistent with some form of computer guidance.

Furthermore, the final paths, attained via the indirect and precision maneuvering, are logical from the point of view of automated guidance aimed at ensuring the aircraft fully impacted the buildings and, for the Pentagon, ensuring that only one wing of the building was hit. For the Twin Towers, guiding the aircraft so that they line up to impact in the center of and perpendicular to the faces of the buildings would minimize the risk of either missing the building or striking a corner. In addition, the last-second pull-outs, which were not necessary to impact the building, would be consistent with the need to have the aircraft impact at a specific height of the building. Also, as discussed above, the subtle and incremental heading changes avoided giving away — via larger heading changes or lining up too far from the building — the use of automated technology to line up with a perpendicular track, while the final last-second turns would have helped make the flight path appear relatively uncontrolled. The final turns and pull-outs might also have been a function of a terminal precision guidance system that operated only in the very final stage of flight.

Regarding the Pentagon, aligning the aircraft with a relatively horizontal path that takes the aircraft into the side of the building would minimize the possibility of it striking the building roof and causing damage to the other wings of the Pentagon. If the aircraft had approached at a steeper angle, the possibility of the aircraft impacting the roof area would have been increased.

Necessity of Airplanes Strikes Given Plan to Demolish WTC Towers

Finally, if we accept that the Twin Towers and World Trade Center Building 7 were deliberately destroyed through pre-planned controlled demolition — a claim for which the physical evidence is overwhelming and beyond reasonable doubt (Robinson, 2024) — and that the cover for this involved aircraft striking the buildings, it is unlikely, from a logic standpoint, that the planners would have chosen to rely upon a highly unpredictable plan of would-be suicide hijackers

both successfully commandeering multiple airliners and then successfully flying them to the targets. Furthermore, ensuring the aircraft hit centrally and fully would be essential to creating the illusion of damage severe enough to cause the towers to collapse. In addition, creating the illusion of the upper sections of the buildings crushing the lower sections would likely have required the aircraft to hit at specific heights that hijacker pilots could not possibly have been relied upon to execute, and the demolitions would probably have been planned around designated points of impact. Only automated control of the aircraft would have provided sufficient guarantee of success in all of these respects.

Table 3: Consistency of Findings with Manual versus Automated Control

Findings	Manual control	Automated control
Indirect routes from point of takeover	inconsistent	consistent
Unnecessary and counter-intuitive demanding final-second maneuvers	inconsistent	consistent
Precision flying required to complete the demanding final maneuvers, including foreknowledge of aircraft handling at high speed	inconsistent	consistent
Specific final tracks into buildings	inconsistent	consistent
Deliberate destruction of WTC buildings requiring highly dependable aviation cover story	inconsistent	consistent

Alternative Scenarios

One alternative interpretation of the data is that the aircraft were manually flown by the alleged hijackers and that the observed routes and maneuvers were the consequence of mistakes and luck. Although this scenario cannot be ruled out with certainty, for it to be true, the following points would have to be accepted:

- That rather than flying directly to their intended targets, the alleged hijackers accidentally flew — in three separate cases — convoluted and time-consuming routes, and in doing so increased the risk of interception and therefore mission failure.
- That having maneuvered the aircraft to locations close to each target, the alleged hijackers then needlessly placed the aircraft — in three separate cases — in positions demanding either a higher level of flying skills or luck in order to avoid mission failure.

- That after mistakenly placing the aircraft in positions demanding either superior flying skills or luck in order to avoid mission failure, the alleged hijackers — in three separate cases — had the superior flying skills or good luck to avoid mission failure.
- That having mistakenly flown convoluted routes and avoided mission failure in the last seconds, the aircraft ended up flying almost exactly the same perpendicular paths into each of the Twin Towers — both involving remarkably similar final turns and pull-outs from steep descents — and, for the Pentagon, a level path straight into the side of the building that ensured only one wing of the building would be impacted.
- That having carefully over a long period of time planned for the controlled demolition of three buildings in New York, the cover for which needed to be aircraft impacts, it was decided to rely upon a group of individuals, motivated to carry out kamikaze attacks, to successfully commandeer and then fly the commercial airliners into specific points in the buildings that would create the illusion of sufficient damage to cause the collapses and would align with the design of the demolitions.

Each of these propositions, taken alone, is arguably plausible but unlikely. Taken together, the probability of all five propositions having occurred and across three separate flights is extremely unlikely.

A second alternative interpretation of the findings is that the routes were actually intentional and perhaps practiced, perhaps with the use of at-home flight simulators (since instructors in full motion simulators would have been unlikely to allow these routes to be practiced) or in institutional simulators, possibly even at US military bases (research is needed to confirm whether or not reports that some of the alleged hijackers received training at US military bases are true). While this scenario also cannot be ruled out with certainty, it is difficult to reconcile this interpretation with the findings for the following reasons:

- Planning and practice do not explain the convoluted and time-consuming routes flown. Careful planning and practice would have avoided these.
- Planning that involved placing the aircraft, in the final seconds, in positions that inevitably increased the risk of mission failure is not logical. Careful planning and practice would have avoided this. In the unlikely event that the alleged hijackers chose specific waypoints to navigate to that would conceivably cause them to fly an offset, they would have aligned with the targets as soon as the targets became visible. They would not have waited until the final seconds to align with and reach the altitude of the targets.
- If the objective was to create a terrorism spectacle by crashing into the buildings, there would have been no need for the kinds of precise targeting

indicated by the final routes flown. The aircraft could have simply been flown into the buildings via the quickest and most manageable routes.

- The idea that would-be hijackers, intent on carrying out suicide attacks on targets in the US, would have been training to fly these maneuvers at US military sites lacks *prima facie* plausibility. If operating undercover, they would have exposed themselves to obvious high risk of discovery. If the US military and would-be hijackers were fully aware of each other or working together, it is almost impossible to rationalize how this would have worked in practice, with the hijackers puzzling over why the US military would facilitate them to train for an attack on US targets.

CONCLUSIONS AND FURTHER RESEARCH

The pattern of evidence — derived from the flight simulation exercises and analysis of the flight paths — fits better with the automated control hypothesis than with the manual control hypothesis. Importantly, the findings refine our understanding of precisely why manual control is unlikely: The central issue is not that the basic task of piloting the aircraft in order to hit the targets is too difficult, but rather that the actual routes and maneuvers flown were unnecessary, counter-intuitive, and relatively difficult to complete, while the obvious and readily accomplishable routes one would expect if the aircraft were under manual control were not taken. Automated precise and deliberate targeting provides a coherent and logical explanation for the otherwise unnecessary, counter-intuitive, and difficult routes performed on 9/11.

These findings contribute to our wider understanding of the events of September 11, 2001. The larger context beyond the airplane strikes is that we now know there was a plan in place that morning to demolish the World Trade Center Twin Towers and Building 7. The evidence for this claim is overwhelming and beyond doubt. Given that knowledge, logical inference strongly suggests that the planners of these events needed to ensure that aircraft hit the Twin Towers in order to have a cover for the destruction of the buildings. The planners would therefore not have relied upon a highly unpredictable plan of would-be suicide hijackers both successfully commandeering multiple airliners and then successfully flying them into the targets with enough precision to make it appear that the damage was sufficient to cause the collapses. This study, by providing evidence for the automated control scenario, corroborates this inference and, in doing so,

strengthens confidence in the overall thesis that 9/11 was a false flag event and not a terrorist attack by Islamic fundamentalists.

Continued analysis of the flight paths and information from FDRs is warranted. Although FDRs for AA11 and UA175 were reported to have never been found, claims exist that they were recovered (Barrett and Bellone, 2011: p. 189).² Further inquiries should be made into the possibility that these exist, followed by attempts to force the authorities to release the data. Information from these FDRs could provide additional evidence regarding the maneuvers carried out during the final minutes and seconds of flight, and this evidence could be cross-referenced with the evidence presented in this study.

In addition, the FDR retrieved from the wreckage of AA77, used in this study to identify the flight path and final maneuvers, requires further examination. Claims have been made that some of the FDR data showing larger variations during non-autopilot phases compared to autopilot phases is “confirmation” of manual control (Coste, 2025). Here, further analysis is necessary in order to determine whether the FDR readings during these phases indicate manual control or, instead, simply reflect a different control system. Further analysis is also warranted into FDR data that shows a high degree of precision during the final seconds of AA77’s flight. Specifically, the heading deviations during the final 30 seconds of flight are less than the deviations during autopilot phases. An FDR was also recovered for UA93, and the argument has been made that it also indicates erratic control consistent with manual flying as well as other features that are consistent with the passenger rebellion on that aircraft described in official accounts (Coste, 2025). Further analysis is needed to evaluate the strength of these claims as well as the alternative hypothesis that UA93 — like AA11, UA175 and AA77 — was also under automated control.

Generally, analysis based solely on the FDR data needs to consider the extent to which this data can be relied upon to make robust inferences regarding manual versus automated control. The FDR data was supplied in digital form and is, potentially, vulnerable to manipulation. In addition, the maneuvers indicated by the FDRs from UA93 and AA77 could just have easily been performed via remote or automated control as by manual control. The evidence for automated control of AA11, UA175, and AA77 — based upon the findings in this study, which draw upon a combination of different evidence — would suggest, at the very least, that FDR-based claims for UA93 and AA77 be treated with caution.

2 FDNY Firefighter Nicholas DeMasi of Engine Co. 261. describes that “At one point I was assigned to take Federal Agents around the site to search for the black boxes from the planes. . . . We loaded up about a million dollars’ worth of equipment and strapped it into the A.T.V. . . . There were a total of four boxes. We found three.”

Regarding flight paths, a fuller examination of the earlier stages of the flight paths is warranted to understand better the rationale for the convoluted indirect routes. One area of inquiry concerns AA77's delayed U-turn and loss of radar tracking during this period. Another claim concerns the timing and sequencing of the takeovers, whereby each hijacking occurred shortly before the preceding aircraft hit its target, suggesting a degree of coordination that would have been impossible for four separate hijacking teams (Inan, 2025).

Further investigation, building on the work of Monaghan (2008 & 2026), is also needed into the possible guidance systems that could plausibly have been used to control the aircraft. Further examination of flight and airport logs, including ACARS data that some have argued does not align with the reported flights, is also needed.

More widely, evidence in support of the automated control hypothesis links with other issue areas that require continued and fuller examination. These include the veracity of the alleged hijacking events (Davidsson, 2013; Walter, 2024; Ryan, 2023), evidence about whether the alleged hijackers actually boarded the aircraft in question, and intelligence agency surveillance of and facilitation of the alleged hijackers in the lead-up to 9/11.

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APPENDIX 1: VIDEO OF FIRST ATTEMPT SIMULATION RUNS

Click on the hyperlinked text to view each simulation run (please note that on some videos sound and image are restricted in order to protect anonymity).

	South Tower Direct Route	Pentagon Direct Route	South Tower Indirect Route Maneuver	Pentagon Indirect Route Orbit Maneuver	Pentagon Indirect Route Low-Level Maneuver
Pilot 1	Cockpit view 3-D view	N/A	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 2	Cockpit view 3-D view	N/A	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 3	3-D view	3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 4	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 5	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 6	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view
Pilot 7	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view	Cockpit view 3-D view

APPENDIX 2: COMPLETE RESULTS TABLE

The complete results table is available [here](#).