MH370-CAPTIO study

Report: www.mh370-captio.net
Trajectory video: https://youtu.be/Jd_eJIINlBw
Debris: drift video https://youtu.be/ZaQYUrjhBCM

Goal:

The purpose of the MH370-CAPTIO study is to help locating the wreck of the Boeing 777-200ER (9M-MRO) of Malaysia Airlines, which disappeared on March 8, 2014, during its flight MH370 from Kuala Lumpur to Beijing. Thus, thanks to the discovery of the wreck, the authorities concerned could, we hope, determine, at least in part, the cause of this disappearance and answer the questions posed by relatives of the passengers and of the crew. In addition, this could help the aeronautical community to improve the safety and security of air transport and make search and rescue more effective.

Data used :

The information that formed the basis of the study is: all the relevant data from the official report, published in March 2015, the radar and satellite data (Inmarsat), the publications of the scientific community (mainly the Independent Group / IG [1]) and information derived from the recovered debris.

The " final report " of 02/07/2018 published on 30/07/2018, disappointed the families and friends of MH370 passengers and crew. From our point of view, both the content of this report and what is left unsaid reinforce our analysis.

At present, nobody having worked seriously on this disappearance can still believe that it is the consequence of an accident and/or some severe damage. The only logical conclusion is that it is the result of a hijacking.

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1 A network of around 20 pilots who, since the beginning, has been working on the MH370

A Certain assumptions must be questioned

A.1 Lessons learnt from unsuccessful searches

The failure of the three research campaigns (the first two conducted by the Fugro company, piloted by the Australian Transport Safety Board (ATSB), and the most recent by Ocean Infinity) must call into question the assumption of a trajectory in a straight line approximately at the cap 180 °, due to a sudden incapacity of the crew, or to a suicidal behaviour of the captain after 1h40 of a mastered precise piloting.

A.2 Were the pilots involved?

The "final" report excludes the involvement of the pilots and speaks of "third party". It also excludes the possibility of the Captain's personal simulator use to plan this flight even though various points compatible with a simulated flight in a straight line to the south were found.

So, either the pilots could have been forced by People in Command to act against their will, or they could not have piloted at all after the highjack had begun.

A.3 Why was it most likely not a pilot's suicide?

From the information coming from the military radars concerning the known trajectory of the plane, one can note that several very busy airways were crossed and / or avoided in full safety. In addition, the results of the fuel consumption calculation allow to say that the flight lasted approximately 7:30 until fuel exhaustion. These elements support the conclusion that such behaviour is not suicidal when comparing with the few known occurrences of suicidal will of a pilot,

A.4 Were some passengers involved?

Officially, all passengers were considered out of cause, even the two persons having boarded with stolen passports. But it is possible, on the one hand, that there were accomplices on board with passports in good standing and, on the other hand, that a person could have smuggled himself with a weapon or that a weapon could have been introduced before the flight.

Airport parking areas, aprons and gates are weak points in the security chain. At night, it is very easy to access a plane at its parking or at its gate.

In particular, someone could have easily accessed the aircraft hold and get to the Main Equipment Centre (MEC) where all the control systems are located, allowing this intruder to simultaneously cut off the power supply to all means of communication at a well-chosen, convenient time

A.5 How can unauthorized people enter the Main Equipment Centre (MEC)?

The B-777 MEC, also known as Electronic Equipment Bay (EEB), is a room located under the cockpit, accessible through 3 possible doors: one near the front landing gear, one communicating with the cargo hold and one in the floor of the passenger cabin just outside the cockpit door.

At night, it is easy to enter during aircraft maintenance operations and to remain hidden throughout the beginning of the flight because the EEB is pressurized. The EEB is where the main circuit breakers of the electrical systems are located. It should be noted that switching off the power supply would also unlock the electromagnets that keep the cockpit access door closed.

A.6 Why was Christmas Island the targeted destination?

We assumed that the People in Command would neither kill their passengers nor make the plane disappear, but land safely on a sufficiently long runway by navigating via waypoints of the aircraft's navigation standard database. We have determined a plausible trajectory fulfilling the constraints of low altitude flight (necessary to progress unnoticed), which ends close to Arc-7 and which would have allowed, if the flight had been perfectly planned, to reach Christmas Island located south of Java

A.7 Was the cabin depressurized or else why didn't the passengers react?

No information is available to determine whether the cabin was depressurized at any point in time. If the hijackers announced their intention to land safely somewhere, the passengers surely were not encouraged to attempt a takeover. Moreover, if armed people were present in the cabin, any rebellion attempt could have been neutralized easily.

A.8 Were there other possible destinations?

Taking into account the Inmarsat data, it is mathematically impossible for the plane to have been able to fly to Diego Garcia's US military base. The on-board fuel would not allow to reach the Australian mainland and finally the island of Java is incompatible with the CAPTIO assumptions of circumventing Sumatra while remaining sufficiently far from the coasts to avoid triggering an intervention of the Indonesian authorities.

A potential destination could have been the Cocos Island, which has a sufficiently long runway that would have been easily accessible given the amount of fuel required. But the Inmarsat data, the speed profile and the fuel consumption indicate that the plane flew far beyond this island. In addition, a slowdown manoeuvre (a holding for example) should have taken place between the Arc1 and Arc2, which is in contradiction with our flight hypothesis "on the run", avoiding to attract attention. The People in Command wanted to go as quickly as possible to their destination (minimum distance strategy) while avoiding as much as possible radar detection (low flying) and minimising the risk of collision with civilian traffic.

A.9 Why didn't fishing boats and freighters see any debris in the estimated area of the end of the flight?

A few days after the disappearance of the aircraft, little debris were pushed southwards (especially because of the tropical storm Gillian) by the sea currents and the wind, far from the maritime routes. When the surface search began, this debris would have already been moved west, away from Arc-7 where the search was focused. In addition, in this region, the density of the maritime traffic is low, and it would have been difficult to detect small debris from the deck of the large vessels.

A.10 Why no aircraft wreckage has been detected on satellite images?

Tomnod users (identifying objects using satellite images) reported that, on that day, clouds in the Christmas Island area were hiding the surface of the ocean.

B The trajectory derived by CAPTIO and the aircraft piloting

B.1 CAPTIO hypotheses

The trajectory determined by CAPTIO is based on 7 hypotheses:

1. The aircraft was piloted from start to end by People in Command;
2. The piloting respected the airspace structure and routes as well as the flight mechanics and piloting rules;
3. The aircraft was not damaged but was only voluntarily and temporarily electrically degraded since the electrical power was restored approximately one hour after deviating from its flight plan;
4. People in Command wanted to land safely on a runway of adequate length;
5. The flight path was simulated based on the aircraft's ability to select the most appropriate flight mode to continuously adjust the aircraft speed automatically. It has also been simulated to minimize the risk of detection by terrestrial radars south of Sumatra;
6. No deceleration or holding was simulated, as the assumption was that the aircraft was on a minimum distance journey;
7. Due to the low number of debris found, a ditching is very likely, possibly with a final crash at low speed.

B.2 Which data were used for the trajectory computation?

The trajectory computation constraints aimed at avoiding as much as possible the civil and military radar coverage south of Sumatra, to pass safely under the airways encountered, to allow the aircraft automation to manage the optimal speed for optimal fuel consumption and to reach a runway compatible with this type of aircraft. The official navigation reporting points were taken into account because they were available in the flight management system database (Flight Management System / FMS). The only manual interventions taken into account are the inputs to the FMS of successive flight levels and vertical speed to pass under the airways during their crossing.

B.3 What was the flight mode after the first reconnection of the Inmarsat telecommunication system?

In the B777, the FMS calculator continuously computes the most efficient speed for fuel consumption based on the phase of flight, the flight path, the aircraft weight and the meteo. In our simulations, from the altitude of 33 000 ft (at 02 :25 local time) and until reaching 5 000 ft altitude (around 05 :40), the FMS selected the mode "economic descent" with a relative speed to the air Knots-Indicated Air Speed (KIAS) of 240 kt considering that the aircraft had actually started its descent. Physically a constant KIAS results in an absolute flying speed decreasing as a function of the decreasing altitude.

B.4 What were the altitude and the speed after the descent in Melbourne's Flight Information region (FIR)?

At approximately 5:50 am local time, the cruise mode was selected. Since the altitude has been stabilized at 5,000 ft, the KIAS set point was automatically set at 285 knots (kts) by the FMS. This resulted in a slow and variable ground speed of about 300 knots as the weight of the aircraft decreased. The aircraft maintained this speed and altitude until its final descent just before the attempted ditching.

B.5 How was the trajectory computed?

To determine the trajectory, the principle was to make best use of the data published by Inmarsat, respecting the flight mode automatically selected by the FMS of the aircraft, the constraints imposed by the airspace structure and the air traffic control procedures. This leads to a realistic operational trajectory for computing the BTO (satellite distance offset) and BFO (frequency shift ~ Doppler). Then we compared these results to the so-called "original" data measured by Inmarsat and graciously provided by the Independent Group[2]. **The match between these two sets of data validates our trajectory**. We made the assumption that human intervention had been reduced to a minimum: input of 4 decreasing altitudes at report points, with a standard vertical speed and a transition to the cruising flight mode at the very end of descent to 5,000 ft. The segments between the reporting points are direct routes and no route deviation has been considered.

B.6 There are few other possible trajectories

Given the number of possible human interactions, a whole range of trajectories could be envisaged to reach Arc7 by a piloted trajectory. But the solutions are reduced in number if one assumes a safe landing and the need of keeping the aircraft within its flight envelope. Other trajectories could be simulated by modifying manually the speed of the aircraft many times, but this would be irrational and dangerous to quit the optimal management done by the FMS. Like us, the Independent Group has envisaged trajectories including holdings where the aircraft would respect predefined standard speeds or preferably execute these loops at the optimum speed. A complementary analysis would certainly prove that a set of trajectories, going further north, could be compatible with the results of the CAPTIO study.

B.7 Why did these knowledgeable people fail to manage the fuel consumption?

The CAPTIO study does not provide definitive answers to this question. There are several items that the People In Command may have not been aware of. First, the right-hand engine consumed slightly more than the left one, approximately 150 kg/h, which is more than a ton of fuel missing at Arc7. Secondly, there is no information from the aircraft and the engines manufacturer on the actual fuel consumption at low altitude, in particular at 5,000 feet and for such a long time. Thus during the flight, the FMS does not provide reliable forecasts of fuel at destination. In our simulations, the FMS displayed approximate values that evolved very quickly at the very end of the flight, leaving little time for People in Command to react.

In addition, we have no information on the degree of piloting mastering of the People in Command (for example, people, who practiced only on a flight simulator, could have misjudged the situation).

C A plausible hijacking scenario

The beginning of the flight shows that a hijacking took place in an area very well suited for such an action. The remainder of the known flight proves that the People in Command had acquired a very good knowledge of the airspace structure, of the air traffic control procedures and of their weak points.

For example, the aircraft disappeared and turned several times at key moments to direct searches to locations that are in line with the trajectory followed just before each turn. This behaviour demonstrates a will not to be detected.

2 *See http://mh370.radiantphysics.com*

C.1 Why hijack the aircraft precisely at this location i.e. 41 minutes after takeoff ?

The area of transfer of responsibility between two Flight Information Regions (FIR) is particular because the pilot must leave one control centre for another with the responsibility of contacting himself by radio the next control centre.

At the location of the MH370 hijacking, this transfer area is almost twice as long as usual since a small band of Singapore FIR, which has since been delegated to Kuala Lumpur, is sandwiched between Kuala Lumpur and Ho Chi Minh adding few minutes of latitude to the transfer procedure compared to the one in place before the agreement with Singapore, which is a very good time to perform a hijacking. According to the Letter of agreement between Kuala Lumpur control and Ho Chi Minh control, IGARI is the transfer point.

The pilot should have called the following air traffic controller via his VHF radio. But no call has been placed. The Vietnamese controller had to wait for the MH370's pilot to call him unless the elapsed time (left to his discretion) led him to contact the missing aircraft (and other aircraft near the intended flight path of the MH370).

In addition, failures of on-board telecommunications systems are not uncommon. In particular, the transponder could stop responding to radar calls for various reasons (system failure or human errors). In such a case, the controller must assume that the aircraft whose identification label no longer appears on its screen is still following its flight plan.

Meanwhile, the controller in Kuala Lumpur had removed MH370 flight from its operational mental process, especially since the indication on his screen told him that he was no longer in charge.

Following its recent work on Kota Bharu's radar data, the Independent Group concluded that the aircraft had probably climbed and accelerated just after its U-turn. In case of an emergency, a pilot would have done the opposite: he would have descended and, because of air density and aircraft structure constraints, he would have reduced the speed while turning back to and land on a runway in Malaysia. Our interpretation is that after the hijacking, the aircraft accelerated to get away from that area as quickly as possible in the opposite direction to the flight plan.

C.2 Why did the Malaysian authority fail to trigger SAR operations (Search And Rescue) earlier?

After an aircraft has been declared missing by the civilian controllers, the air force may be called upon to intervene. SAR (Search And Rescue) operations are usually launched only after this coordination between military and civilian ATC. In this area of uncertainty, selected on purpose for hijacking MH370, a significant amount of time elapsed before the aircraft was recognized as missing. In addition, erroneous statements from the Operations Centre of Malaysian Airlines added to the confusion.

C.3 Why wasn't the aircraft detected by the Malaysian military air defense system?

All radars are monitored by human operators, even though radar processing includes automated signal processing algorithms – called data fusion - for merging data between civilian primary data, secondary radar data and military radar data. These controllers are responsible for assessing the threat level of intrusive flights.

In fact, at about one o'clock in the morning, the plane was seen by the Malaysian military but its trajectory was not threatening, and because of its U-turn, they did not realize it was the diverted MH370.

Indeed, the aircraft remained in Kuala Lumpur's area of responsibility until it entered the Chennai FIR (India). He hid in traffic, behaving like a normal civilian flight having a non-critical problem with its telecommunication system. It safely crossed the airways under their minimum flight level or above their maximum flight level. Then, the aircraft made a rapid descent, a change of course and speed, always respecting the security measures, compared to the civilian traffic.

<u>Our conclusion, like that of the Malaysian authorities' final report, is that the level of threat was considered too low and did not warrant the initiation of an interception operation.</u>

A posteriori, the trace of the plane was found in the records and it was much easier to understand that it had a very unusual behaviour that should have triggered an intervention.

Notes on radar data:

1. raw data from Malaysian military radars are not included in the reports

2. Sabang's Indonesian military radar should have recorded some traces of the MH370 trajectory. Unfortunately, the Indonesian authorities have not published any information.

A judicial investigation conducted by the Gendarmerie des Transports Aériens française (GTA) is under way.

It is led by an examining magistrate who has issued an international judicial commission requesting to those countries likely keeping raw data, the authorization (and possibly their assistance) to seize them. Depending on whether or not there are agreements on mutual legal assistance between France and these countries, such requests are frequently unsuccessful. It seems that, for the moment, the Inmarsat data are the only one at stake. But we think that Indonesian radar recordings would be at least as useful.

C.4 Why wasn't the aircraft detected by civilian primary radars?

The civilian radars capable of detecting the aircraft were approach radars assisting the controllers in correctly sequencing airport traffic during the landing phase. Thus, the "ghost" route of the MH370 did not concern them because it was out of their responsibility.

However, some data of the trajectory, including that of the MH370 from the Kota Bharu radar, containing "holes" due to typical cones of silence of approach civilian radars, have recently been provided by the Malaysian authorities.

C.5 Why was the co-pilot's GSM detected?

South of Penang, the co-pilot's GSM phone was briefly detected by a ground station without establishing a call.

The GSM communication network is a terrestrial network whose antennas are designed and installed to communicate with mobile phones on the ground. The antenna beams are facing down. A signal from a high-altitude mobile phone may be received temporarily and randomly through the antenna beam side lobs, but for a very short time, and this would not allow not establishing a complete connection.

D Debris drift computations have been redone by CAPTIO

Our calculation of the debris drift starts from the attempted ditching point of our plausible trajectory and uses the actual meteorological data for the duration of the drift until August 2015. It takes into account the important influence of the Hurricane Gillian. It does not rely on retro-drift statistics.

The calculation of the drift used the CSIRO model for the type of flaperon debris with a strong wind calculated with a real replication of the flaperon (cf CSIRO report "The search for MH370 and ocean surface drift - Part II", EP177204 dated 3 October 2017)).

A specific report has been produced on this subject (see www.mh370-captio.net) and illustrated by a video (https://youtu.be/ZaQYUrjhBCM)

D.1 What can be concluded from the computation of debris drift?

CAPTIO has studied and modelled the drift of a flaperon between latitudes 9° S and 30° S along Arc7.

In the limit of the resolution of the grid of initial points used, we found that, the more the End of Flight point is located in the south along Arc7, the less the debris remain in the warm waters and the faster they touch the African coast and that of La Reunion for those which actually arrive there. For debris starting from the north of 11° S none of them reached La Reunion. Of those leaving south of 26° S, very few have reached Reunion in time.

Our main conclusion is that, the probability of reaching La Reunion is the highest for latitudes in the range [11° S, 26° S], and especially around 12° S which gives consistent arrival dates compared to the date the flaperon was found.

Moreover, for those items that reach La Reunion, the flaperon drift paths modelled from the end point of the trajectory CAPTIO (12° S) remain constantly in warm tropical waters. This is in keeping with the size of the barnacle shells found on the flaperon.

Other studies conducted by different institutions lead to some similarities, but they are less precise because they did not use actual meteorological data, but other sources of information from buoys, for example, reversal of drift (so-called retro-current method).

A video on this study has been published at https://youtu.be/ZaQYUrjhBCM.

E The teachings of the final report

The so-called 'final report' of 02/07/2018 distributed on 30/07/2018 reads:

The hypothesis of an accident does not justify the changes of trajectories observed and that the pilots can not be at the origin of a hijacking but that "a third party is not excluded" (which was also our main hypothesis for starting the CAPTIO study)

There is no critical analysis of:

- the weaknesses in the archaic procedures of the worldwide ATC leading to "mistakes" made by the controllers (which led to the resignation of the Malaysian DGAC);
- the flight path of the aircraft and why it was not considered a threat because it was following airways at the FIR border at intermediate levels to hide in the civilian traffic;
- the simplistic Australian hypothesis (the ATSB) which assumed that the aircraft was following a straight trajectory for 6 hours without a goal;
- the reason for the failure of expensive search (cost that moved the Australian Senate);
- the unsuccessful study of retro-currents made by CSIRO;
- the consequences of overconsumption of one of the engines

All of these findings allow us to reinforce our analysis of a missed hijacking due to a poor estimate of fuel consumption due to over-consumption of an engine and low-level flight in South Sumatra.

With the publication of the so-called "final report" Anwar Ibrahim, who is the main ally of the current prime minister and who is expected to take the reins of the Malaysian government in one to two years, said, "It's up to our national security to know exactly what happened with this aircraft." and he made a forceful pledge to restart some investigations.

The French investigating judge has issued an international judicial letter asking the countries likely to store raw data, authorization (and possibly their assistance) to seize it. It seems that, for the moment, it is the Inmarsat data.

In fact, the so-called "original" data measured by Inmarsat has long been graciously provided by the Independent Group. See http://mh370.radiantphysics.com/2017/06/12/the-unredacted-inmarsat-satellite-data-for-mh370/

These are the records of Indonesian radars that would be useful and that would validate our trajectory.

The search area proposed by CAPTIO is compatible with all available official data concerning flight MH370.

The costs of search in such a small area, located in tropical waters, therefore accessible all year round and close to the coast of Indonesia, would be low compared to previous research.

Speculative issues such as the analysis of hijackers' motives or the absence of any claim for responsibility in the hijacking are beyond the scope of the present study.

Helping to find the wreck is the only objective of our team. Our work is based on our in-depth knowledge of the operational reality of air traffic control and of civil-military co-ordination (or absence thereof), which allowed us to take account of some revealing details that have been overlooked by experts coming from other technical fields.