A Bayesian Maritime Search Model for Missing Aircraft

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Abstract

In this paper, we present a statistical analysis that finds an optimal search zone used to locate missing airplanes. Our model has 2 goals: efficiency and effectiveness. We desired to narrow the search target area and to speed up the search process by eliminating relatively minor factors. Following the lead of Lawrence Stone with Metron Scientific Solutions, we turned to Bayesian inference to create our model. To do this, we calculate the probability of location in order to estimate the likelihood that the aircraft is in our highest priority area using a Gaussian distribution. Afterward, we applied techniques like the probability of detection for finding the transmitters, and the marginalizing of uncertainties for things like weather. Blending the results of these calculations, we created a model that highlights a primary search zone, a secondary search zone and suggests a search strategy. We applied our model to several well-known cases, such as Air Asia Flight 8501 with accurate results. In addition, we have included in this paper a conjecture about where we think Malaysia Flight MH370 might be found. In all of our test cases, our model was successful in predicting the location of the downed planes, and might prove useful in future investigations.

Contents

1 Introduction

In this paper, we present a Bayesian statistical model to aid in the search for planes presumed lost at sea. Since time is of the essence with downed aircraft, our goal was to maximize effectiveness and efficiency. Our model develops a radius of probability using the last known position of the plane as the significant determiner of where the plane is likely located. Specifically, we use a Gaussian distribution and the plane's last known location to construct a series of concentric circles of varying standard deviation radii to generate areas of highest likelihood of success. Using the method of Bayesian analysis, we then find a more pertinent search area factoring in probability of detection which deals with the likelihood that the aircraft will be located acoustically. We marginalize out the weather, water currents, and debris due to the lower impact they have on the priority search area. Our model provides Search and Rescue crews with a grid of the highest priority search areas, as well as a recommended search strategy to generate efficient results.

1.1 Glossary of Terms

Below is a common list of terms used frequently throughout this paper.

- ATC = Air Traffic Control
- CVR = Cockpit Voice Recorder
- ELT = Emergency Locator Transmitter
- FDR = Flight Data Recorder
- LKP = Last Known Position
- nm = Nautical Miles
- SAR = Search and Rescue

2 Our Approach

The beginning of our paper will be devoted to presenting the mathematical and theoretical background of our model, as well as our graphical interpretations and implementation. The later sections of our paper will be devoted to applying our model to notable case studies, assessing the strengths and weaknesses of our model, and applying our model to a yet unsolved case. We will also compare our model with that of an expert, namely Metron Scientific Solutions, as our control. To accomplish these tasks, we complete the following steps:

- **Develop a target area based on the Last Known Position (LKP)** of several known crashes, and generate a series of concentric circles with radii of ascending standard deviations based on the average distances between LKP and their respective crash sites.
- **Compute the probability of location** using Bayesian posterior probability to determine the likelihood the aircraft is within the "highest priority" search area.

- **Find the probability of detection** for the emergency transmitter beacons using Bayesian inference to determine the type of search necessary.
- **Estimate priority search area** by overlapping these outcomes.
- **Recommend a search pattern** to maximize the efficiency of SAR equipment and provide the highest chance of success.

2.1 Assumptions

Due to the large variation of complications that can arise during a flight, both human or mechanical in nature, no two plane crashes will be exactly alike. Below are the assumptions that our model takes into account:

- **The plane is down with no recorded distress signal**. The plane is neither sending nor receiving communications of any kind.
- **Debris has not been found,** and therefore using the idea of reverse drift (tracing debris backwards through wind and water currents) is irrelevant. The plane is assumed to have sunk completely.
- **The CVR and FDR have time and depth sensitive lifespans.** Flight recorders must be able to withstand a depth of 20,000 feet below the surface for an average of 30 days. In our model, we assume a 30 day lifespan.
- **LKP of the aircraft is known.** This includes last radio contact, last radar contact, or last communication between on-board computers and satellites. The geographical coordinates of the aircraft's LKP must be known. This also assumes that the plane's tracking equipment had not died prior to disappearance.

3 A Gaussian Distribution

To address differences in standard deviations[6], we will compare ours with those of Metron Scientific Solutions. Metron is a scientific consulting company that utilized mathematical modeling to provide solutions to challenging national and global problems. Metron is the company responsible for devising a plan to successfully locate the crashed Air France 447 flight. It is led by head scientist Lawrence D. Stone, who is noted as an expert and credited with creating the plan to effectively find AF447.

3.1 Probability of Location, P_L

In the table shown below, we present a standard probability scale for reference.

Certain	**1**
Almost Certain	**.95**
Highly Probable	**.90**
Probable	**.85**
Expected	**.75**
Fifty-Fifty	**.50**
Uncertain	**.25**
Improbable	**.15**
Impossible	**0**

Table 1: Probability Scale

3.1.1 Calculation

In the following table, we present 9 aircraft who crashed into various bodies of water, chart courtesy of Metron.[10] The chart represents the distance in nautical miles that their wreckage was found from their respective Last Known Positions. From this data, we calculated the mean distance between LKP and the actual crash position.

Flight	**nm** from **LKP**
Aeroflot F-OGQS	**3 nm**
Aeroflot RA-85164	**8 nm**
Silk Air 9V-TRF	**5 nm**
IRS Aero RA-75840	**4 nm**
Trans Asia B22708	**2 nm**
W. Carib. HK-4374X	**17 nm**
Pulkovo RA-85185	**3 nm**
Adam Air PK-KKW	**9 nm**
Caspian Air EP-CPG	**5 nm**

Table 2: Distance from Last Known Position to Wreckage

We found the mean distance from LKP to wreckage to be $\bar{x} = 6$ nautical miles, with a standard deviation of $\sigma = 4.4$ nautical miles. After calculating the standard deviation and using the Gaussian distribution, we created a primary search hotspot within a range of 3σ from the LKP, and a secondary hotspot from 3σ to 5σ from the LKP.
This translates to a 99.7% chance that the wreckage is located within 13.5 miles of the LPK. Using this first standard deviation gives us a primary search zone with radius 13.5 nautical miles. The secondary search zone would have radius 22.5 nautical miles.

Our theory is that a primary search zone of three standard deviations would capture the majority of the wrecks, regardless of the size of the standard deviation.

To prove this, we decided to factor in two more wrecks and then apply all three standard deviations to a single wreck site, and see if the recommended hot zone was

accurate. If it was accurate for all three σ when applied to the wrecks, then we felt it was safe to average them into a useful standard deviation.

We then added in AirAsia Flight 8501. The mean distance between LPK increased to $\bar{x_2} = 7$ and the standard deviation increased to $\sigma_2 = 5.8$ nm.
Calculating it once more with Air France 447 while excluding Air Asia 8501, we came up with $\bar{x_3} = 6$ and $\sigma_3 = 4.2$ nautical miles.

3.1.2 Final Standard Deviation

Taking the average of these three standard deviations, we came up with $\sigma_4 = 4.8$ nautical miles, rounding to 5 nautical miles.
Our recommended search targets are computed as follows: the primary search zone is within 3 standard deviations of the LKP, or rather $\sigma_3 = 15$ nm. The secondary search zone is 5 standard deviations away from the LKP, $\sigma_5 = 25$ nm.

Radius (s)	**Our Model**	**Metron**
1 s	5 nm	8 nm
2 s	10 nm	16 nm
2.5 s	12.5 nm	20 nm
3 s	15 nm	24 nm
4 s	20 nm	32 nm
5 s	25 nm	40 nm

Table 3: Search area zones designated by standard deviation radius

Metron appeared to used a primary search zone of 2.5 standard deviations, and a secondary search zone of 5 standard deviations, as they cite their standard deviation as 8 nautical miles.[10] This puts us in similar ranges as far as the priority search area. Their primary zone radius is 24 nm, ours is 15 nm. Their secondary zone is 40 nm, while ours is 25 nm.

	8 nm	7 nm	6 nm	**5 nm**	4 nm	3 nm	2 nm
$P_L : 1\sigma$	**.64**	.64	.55	**.36**	.27	.09	.09
$P_L : 2\sigma$	**.91**	.82	.82	**.72**	.63	.54	.27
$P_L : 2.5\sigma$	**.96**	.91	.91	**.77**	.72	.63	.41
$P_L : 3\sigma$	**.99**	.99	.99	**.81**	.81	.72	.54
$P_L : 4\sigma$	**.99**	.99	.99	**.99**	.90	.81	.63
$P_L : 5\sigma$	**.99**	.99	.99	**.99**	.99	.99	.81
$P_L : 6\sigma$	**.99**	.99	.99	**.99**	.99	.99	.81

Table 4: P_L of aircraft within target search zone of radius σ in nautical miles

For our standard deviation of 5, our initial search zone has a 15 nautical mile radius from the last known position of the aircraft. Our secondary target is 25 nautical miles from the LKP.

The probability of the wreckage being within 3 standard deviations of the LKP for us was .81, while the probability for Metron within 3 standard deviations was .99. This is valid data due to their larger initial search area. However, it should be noted that our initial target zone still fell in the probable rating that the airplane would be located within it.
For both of the standard deviations, the wreckage had a .99 chance of being found within 5 standard deviations of the LKP: 25 nautical miles for our model, and 40 nautical miles for Metron.
It should be noted that Metron's standard deviation was for Air France, and we cannot say how they arrived at their standard deviation or if that is the one they always use.
It should also be noted that our secondary target zone had the same distance as Metron's primary target zone, along with the same probability. Therefore, we simply shrunk down the target region, in order to make the search more efficient.

4 Using Bayesian Inference

4.1 Marginalizing Environmental Factors, P_C

We chose to marginalize out the environmental factors (wind or leeway, currents or drift, weather) for three reasons:

1) We assumed debris has not been found yet, as the plane is lost. Therefore drift and leeway are irrelevant. This being the case, we will assign a probability value of .10 to drift being present.

2) The weather is a factor primarily for successful SAR, which is for the benefit of survivors. The survival rate after a plane crash at sea is low, and since we already assumed the plane is lost, with no debris, then we can assume that weather's main contribution is toward the searchers, not the position of the down plane.[4]

3) The weather is unpredictable, and therefore often uncertain[8]. Since it is uncertain, it cannot be a primary variable in our model, as the slightest change in weather would drastically change the results. In truth, if the plane is already in the water, the surface weather conditions will only matter slightly. Therefore, weather is also not a key factor at the moment.

4.1.1 Calculation

Therefore, using the Bayesian Marginalization of a factor principle, we have the following formula:

$$P(C|A) = \sum_i P(C|A, B_i)P(B_i),$$

where A and B are both factors that affect C. Let A stand for the certainty of the LKP, and B stand for the certainty of the weather conditions, i.e. leeway and drift. Both of these things are important solely if there is debris and possible survivors[11]. As weather conditions tend to be uncertain, the likelihood of survivors in a plane crash is low, and debris drifts away from the scene of the crash at a decent pace, therefore the condition of B will be low. Now, let C stand for the location of the wreckage.

Thus, using the probability of the LKP, we will marginalize out the weather, B, in order to find the location of the crash, C.
To find B, we considered the different weather events to be dependent, and $P(B) = P(\text{knowing exact weather conditions})\text{P(survivors)P(drift staying at crash site)}$ which would be (.4)(.15)(.10) which is .006.
To find A, we consider if the LKP is a registered coordinate and not just a ping, the likelihood would be .94. If the LKP is a ping, the likelihood of certainty becomes .5. Since the likelihood of the transmitter working and giving the coordinates is a dependent event to knowing the LKP, we find the probability of A as follows:

$$P(A) = (.94)(.50) = .47$$

Therefore, we have:

$$P(C|A) = (.94 * .006)(.006) + (.994 * .94)(.94) = .93$$

Therefore, the probability for finding the location of the crash C is .93, and the probability of A affecting C was .94, so the probability of the LKP being accurate affects the location far more than the weather conditions. Thus, we do not need to factor in the weather conditions to calculate the location of the downed aircraft.

4.1.2 Assessment of Results

One caveat to our model is that we marginalize the effect of environmental conditions. In reality, the environment can play an impactful role in determining the final location of a downed aircraft. We can improve our model by taking into account the effects of leeway, drift, and other weather conditions in the future. However, in this paper, we are assuming the airplane is lost, which renders weather conditions less relevant.

4.2 Probability of Detection, P_D

Probability of Detection is the likelihood that the electronic pings from the FDR or CVR will be picked up by acoustic scanning or satellites[2]. This factors into our model for scheduling and equipment purposes. After the batteries in the units die, it is a waste of time to look for them. Also, if they are not working to begin with, then the acoustic equipment will not pick them up, and they need to graduate to SSS.
We are taking into account the probability that there may be only one of them present, or just only one of them working. Our calculation also deals with the likelihood that neither are working, which would mean the ELT would be unable to pick up any signals, as there would be none.
We let P_D represent the probability of the pingers being detected,
P_B both transmitters working,
P_T is only one transmitter working,
and P_N is neither of them working.

If we treat the FDR and CVR as independent variables, i.e. the survival of one does not effect the survival of the other, then we have a Probability of Detection

calculated as follows: The probability of at least one beacon surviving is Bayesian sum of both the probability of one surviving and both surviving.

$$P_D(1) = P_r\{D|B\}P_r\{B\} + P_r\{D|S\}\{S\} = .90$$

The probability of both surviving is

$$P_D(2) = P_r\{D|B\}P_r\{B\} = .80$$

The probability of both surviving when dependent is

$$P_D(2) = P_r\{D|B\}P_r\{B\} = .75$$

The probability for detecting the transmission with no beacons working looks like this:

$$P_N = P_r\{D|N\}P_r\{N\}$$

which becomes

$$P_N = (.10)(.20) = .02$$

Assume that after 30 days, the transmitter battery is likely dead, which gives all the probabilities of detection a time limit. After 30 days, the P_D will be the same as if none were working, or .015.

After 45 days, which is the longest life of a transmitter on record, the P_D becomes 0.

So, while we have assumed in the beginning that the likelihood of the beacons surviving the crash is probable, the likelihood that they will outlast 30 days before rescuers find them is much smaller.

4.2.1 Assessment of Results

1. **Effective Search Area** - The optimal search area we prescribe is 15 nm from the LKP of the downed aircraft. The secondary search area is 25 nm. Naturally, if other known crash sites were factoring into the distribution, the standard deviation would change, thus altering the search area. For now, this seems to be fairly effective.

2. **Efficient Time Search** - The probability of locating the beacons after 30 days is unlikely, so the search methods should graduate from acoustic to side scan sonar, which doesn't depend on the pings to map the area. This switch should take place as soon as possible, if the exact LKP is known, since SSS is more accurate.

3. **Weather Conditions** - The probability that the weather directly factors in to the airplane crash site once it is already down is minimal, at least when no transmissions have been received.

4. **Maximum Distance** - The third and final search area would be the maximum distance the airplane can go on one tank of gas, ceteris parabis. If the on-board transmitters are working, than the maximum distance is 1 hour from the LKP, as the system updates with the satellite automatically every hour.

5 Case Studies

In this section we apply the model discussed above to two recent cases used in creating our model, namely Indonesia AirAsia Flight 8501 and AirFrance Flight 447. We also apply it to two more cases, where the LKP is eithered not specified or vaguely known.

5.1 Indonesia AirAsia Flight 8501

Indonesia AirAsia Flight 8501 was a scheduled passenger flight from Indonesia to Singapore. The flight was scheduled for December 28, 2014. Approximately 42 minutes after takeoff, ATC lost radar contact with the plane, including the loss of the transponder signal responsible for reporting the plane's geographical coordinates. Two days later, wreckage was spotted by search planes, and on January 12, the cockpit voice recorder and flight deck recorder were located. The cause of the crash was determined to be an aerodynamic stall caused by an irregularly sharp climb.

Calculating it with AirFrance 447 while excluding AirAsia 8501, we came up with $\bar{x_3} = 6$ and $\sigma_3 = 4.2$ nautical miles. When our model is applied, the wreckage was located within our standard primary search area.

Flight	**nm** from **LKP**
Aeroflot F-OGQS	**3 nm**
Aeroflot RA-85164	**8 nm**
Silk Air 9V-TRF	**5 nm**
IRS Aero RA-75840	**4 nm**
Trans Asia B22708	**2 nm**
W. Carib. HK-4374X	**17 nm**
Pulkovo RA-85185	**3 nm**
Adam Air PK-KKW	**9 nm**
Caspian Air EP-CPG	**5 nm**
AirFrance 447	**6 nm**

Table 5: Distance from LKP to Wreckage with AirFrance 447

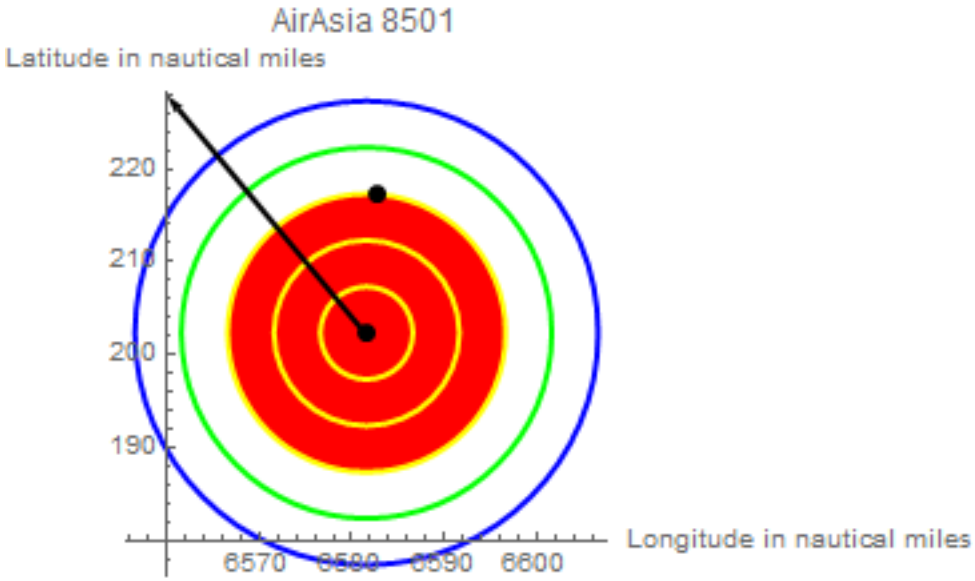

Figure 1: Graph showing the LKP at center of circle, the plane's direction of travel at time of last contact, and where the wreckage was ultimately found.

5.2 Air France Flight 447

Air France Flight 447 was a passenger flight that left Rio de Janeiro, Brazil en route to Paris, France on June 1, 2009. The flight disappeared in stormy weather over the South Atlantic during the early morning hours. Nearly two years were spent searching for the downed plane. It was not until April 3, 2011 with the help of Metron that the wreckage was found on the bottom of the Atlantic 14,000 feet below the surface. Amongst the wreckage, the flight data recorder and the cockpit voice recorder were both found.

We then added in AirAsia Flight 8501. The $\bar{x}_2 = 7$ and the $\sigma_2 = 5.8$ nautical miles.

Flight	**nm** from **LKP**
Aeroflot F-OGQS	**3 nm**
Aeroflot RA-85164	**8 nm**
Silk Air 9V-TRF	**5 nm**
IRS Aero RA-75840	**4 nm**
Trans Asia B22708	**2 nm**
W. Carib. HK-4374X	**17 nm**
Pulkovo RA-85185	**3 nm**
Adam Air PK-KKW	**9 nm**
Caspian Air EP-CPG	**5 nm**
AirAsia 8501	**15 nm**

Table 6: Distance from LKP to Wreckage with AirAsia 8501

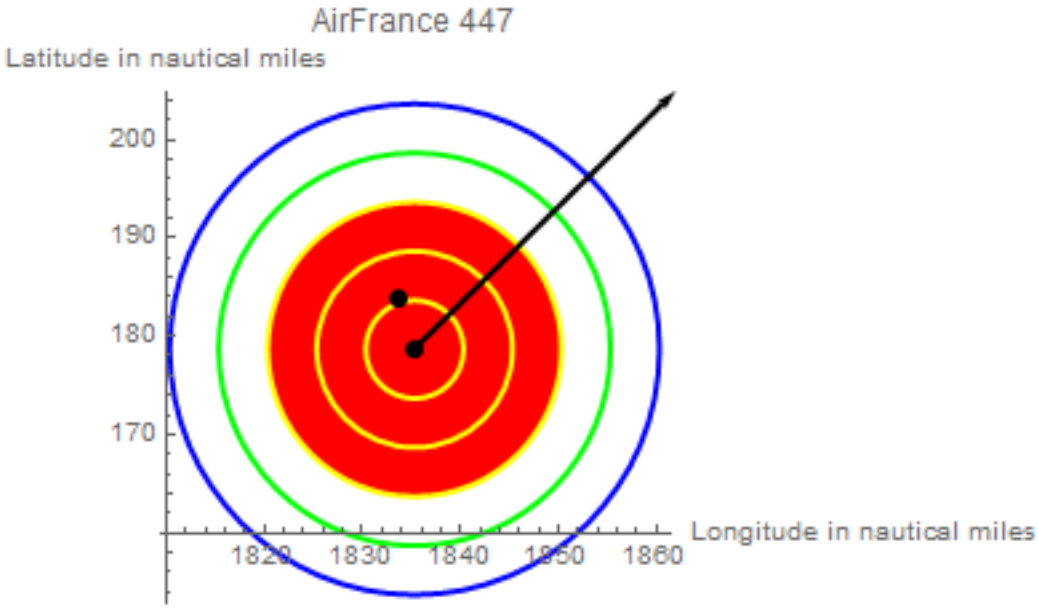

Figure 2: Graph showing the LKP at center of circle, the plane's direction of travel at time of last contact, and where the wreckage was ultimately found.

5.3 African Airlines Flight 295

On November 28, 1987, African Airlines flight 295 crashed into the Indian Ocean. The plane left Taipei, Taiwan and was headed to Johannesburg, South Africa when an in-flight fire combusted. The crash occurred just three minutes after the last contact.The crashed plane was later discovered at 19 °C 10'30"S and 59 °C 38'0"E and the CVR was recovered from a record depth of 16,100 feet, however the FDR was never located.
So if the plane was traveling 500 miles per hour (8 miles a minute) it could be no more than 24 miles away. Therefore, this wreck would be supported by our model.

5.4 United Airlines Flight 389

United Airlines Flight 389 was scheduled to fly from New York to Chicago on August 16, 1965. The flight crashed into Lake Michigan and is believed to have gone down due to the pilot misreading the altimeter. The FDR was found but was not intact.

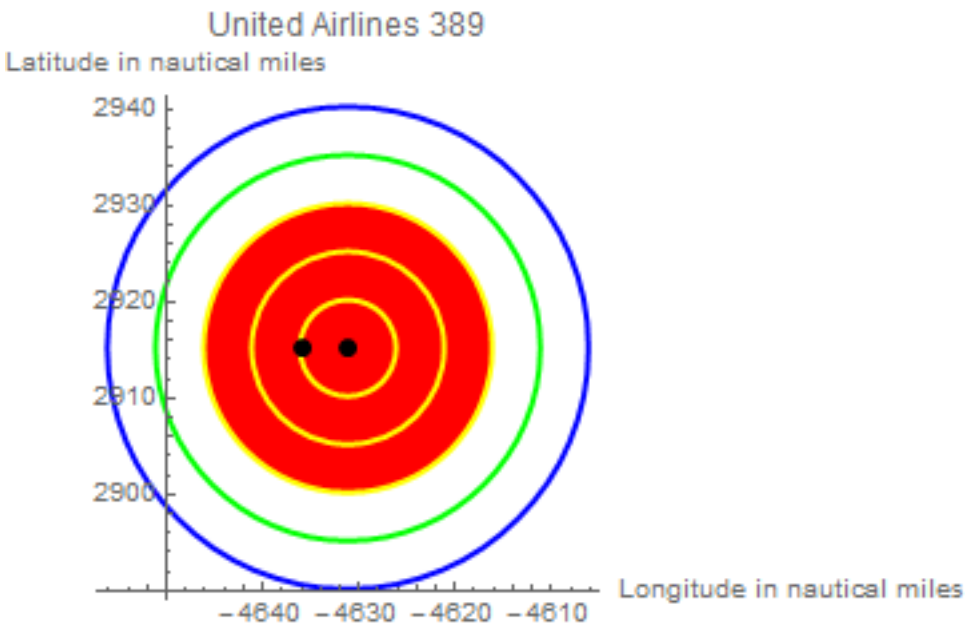

Figure 3: Graph showing the LKP at center of circle,the plane's direction of travel at time of last contact, and where the wreckage was found.

The distance from LKP to crash site was 4nm. This adheres to our model.

5.5 Malaysia Flight 370

On March 8, 2014, the Malaysian Flight 370 disappeared after departing from Kuala Lumpur, Malaysia for Beijing, China. The last known voice contact with ATC was under an hour after take-off while the plane was over the South China Sea. The Malaysian military was able to tract the flight for another hour after contact with ATC before it went off radar over the Andaman Sea. The flight had deviated from its flight path. Analysis of the satellite communication indicate that the flight continued for at least another six hours and flew into the southern Indian Ocean.

When trying to apply our model to Malaysia, we run into the same problem the experts are having. The exact LKP is not known, only estimated. Therefore there is a large range where the plane could be. As previously noted, our model is largely impacted by having the LKP.

5.5.1 Application attempt and results

The Malaysian flight is difficult to apply our model to, as the exact flight location is not known.

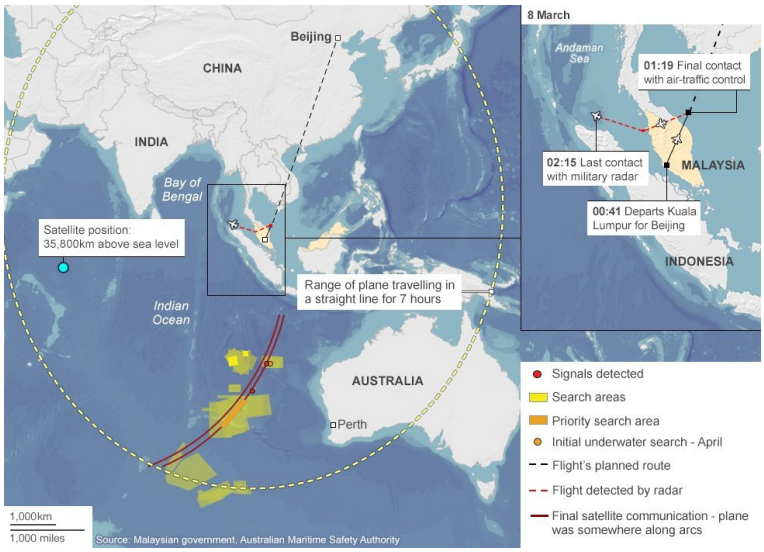

Figure 4: Graph showing the estimated maximum distance 7 hour arc for the LKP

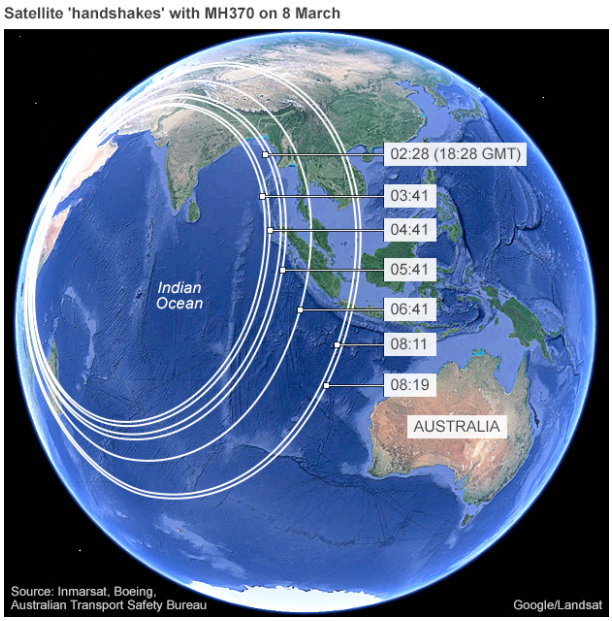

Figure 5: Graph showing the satellite pings and times for Flight 370

Our recommended Search Zone based on our model would be:

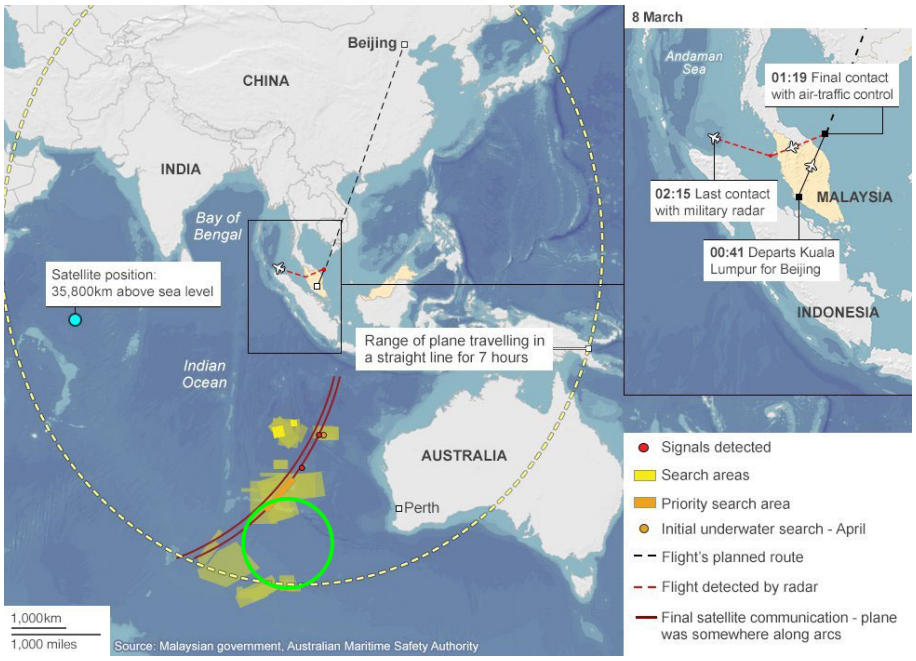

Figure 6: Graph showing out estimated search area

6 Optimal Search Strategy

- Phase I - Normally scan for visual debris but since our model assumes we have none, go to Phase II.
- Phase II - Calculate the probability of detection. If no beacon is present do not use acoustic, instead use side scan sonar or synthetic aperture radar within the calculated primary target zone.
- Phase III - Use side scan sonar or synthetic aperture radar to scan within primary target zone.Repeat with secondary target.
- Phase IV - Use side scanning sonar or synthetic aperture radar to scan within primary, secondary and maximum distance target zone.[1]

6.1 Margin of Error

Due to the statistical nature of our model, we evaluated using a margin of error as opposed to a sensitivity analysis.

6.1.1 Type of Plane Lost

- In some extreme cases, the transponder beacon that relays geographical coordinates to the satellites can be switched off, either deliberately, such as a reboot of the system's automatic control features, or accidentally, such as fuel

exhaustion in flight. When this occurs, the plane may still be airborne, but unable to report their location. For our model, this creates a substantial margin of error, as our model assumes the plane loses contact because of a crash. Future models would need to be more sensitive to the possibility of "ghost" planes, but the chances of this event occurring are very slim.

- The maximum distance possible will change based on type of aircraft. If the transmitters on board are still working, then maximum distance is one hour away at cruising speed (assuming the plane stays on autopilot). Therefore, the only items for which type of plane matters are transponder type and maximum distance.

6.1.2 Type of Plane Searching

- Our model does not account for depth of the water in which the plane has crashed. We are assuming the water is deep enough to lose the plane. While emergency transmitter locators can go fairly deeply, the emergency beacons were not created to transmit at great depths. Thus, if the ocean is very deep at the LKP, the likelihood of picking up the pings from the beacon are slim, using acoustics on boats or planes. The SSS is advised at this level.

- Type of Search plane matters primarily with visual and weather conditions. As most of the planes doing the searching are government, Coast Guard, Navy, and other Maritime organizations, fuel efficiency is not an issue. They have access to an aircraft carrier. Many of the search and rescue maritime vehicles are helicopters also.We did not account for either boats, helicopters, or weather, and therefore this category of search plane was not addressed in our model.

6.2 Suggested Improvements

To further improve our model, there were some ideas that we considered but did not investigate.

- We would look into using least squares best fit circles to help establish an area hot zone. Also, using least squares best fit ellipses in the direction of the flight path or any found debris would lessen the search area.

- The most helpful information appears to be the actual mapping of the ocean floor, which seems to be done slowly, usually in an emergency. There is no universal close up SAR mapping of ocean floor at the moment. They piece it together as they go.

- Our model, specifically the probability of detection, could be improved by taking into account the depth at which the beacon locators become irrelevant because there signal can no longer be detected.

- Lastly, our model does not have any way to account for any false signals that the sonar could pick up in initial search attempts.

- Factoring in drift and leeway to use reverse drift might help, depending on the time-frame.

7 Strengths and Weaknesses

7.1 Strengths

- When applied to the case studies with known LKP, the model was extremely accurate and the crashes fell within the hot zone.
- When the LKP is known, in coordinate form, the model is successful. Since airplanes ping their location every hour, the last known location is generally known. This model also does not rely on a signal from a beacon, which is important because they can become undetectable beyond certain depths and they also only last for an average of 30 days.
- Additionally, this model does not rely on the discovery of debris, so it can be used in more circumstances. The ability to back-trace debris is already known, which is why the model aims to locate a plane in the absence of debris.

7.2 Weaknesses

- When the LKP is not known, the model becomes as general a search plan as the ones currently used.
- The model relies on coordinates in order to be successful and in some cases those coordinates are not known. This is particularly an issue for planes that are under the radar or planes in which the detection devices are disabled such as in a hijacking. For example, the Malaysian Flight 370 the LKP is ambiguous because it was lost before the accident, which makes the model less useful.
- Additionally, we realize that our process does not factor in many other variables (weather, drift, velocity, altitude) and that the actual Bayesian probability would be much more complex.

8 Conclusion

The problem of trying to locate a plane lost at sea given a limited amount of data has proven to be a daunting task. There were many liberties and angles of approach to this problem, each requiring their own degree of creativity. Our method has proven to be an accurate means of determining the location of the aircraft it was designed to find. Our model was able to stand up to that of Metron even though they have significantly more technology than we have access to. By finding the probability of location, we were able to provide SAR crews with a "highest priority" target area. Furthermore, by finding the probability of detection, we were able to refine our "highest priority" search area and tell the SAR crews exactly where they had the highest chance of success at finding the downed planes.

9 Press Release Statement

In our paper, we present a statistical model that finds an optimal search zone used to locate missing airplanes. Our model uses methods of statistics and probability to create a zone of highest priority. Within this zone of highest priority, the vast majority of Search and Rescue resources should be allocated.

The model creates an area of probability in which the highest likely amount of wreckage is contained. This means that our model can provide an area that should be heavily searched using available technologies like Side-Scan-Sonar and Synthetic Aperture Radar. Our model starts with a smaller standard deviation range, and increases as search processes continue. The primary target area using our model creates an area with a radius of 15 nautical miles and a secondary target area of 25 nautical miles.

One supreme benefit of our model is that it adapts. It is not a static model that only presents fact regardless of ongoing evidence. Our model is able to adjust in light of new evidence and provide real time updates to the high priority search areas, enabling Search and Rescue teams to do their jobs more efficiently and not waste valuable time, money,and resources.

The testing of our model on data from prior plane crashes showed that the model was successful in locating it when the last known position was known. We suggest that you utilize our model in addition to standard search and rescue protocol in order to help you locate the area to search for your plane.

For future accidents and their related searches, we advise you to not announce any deaths until the crash is confirmed. Additionally, the mapping of ocean floors with side scan sonar and synthetic aperture radar is a relatively new field, and as such we have yet to map the floors of every ocean. These things take time.

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