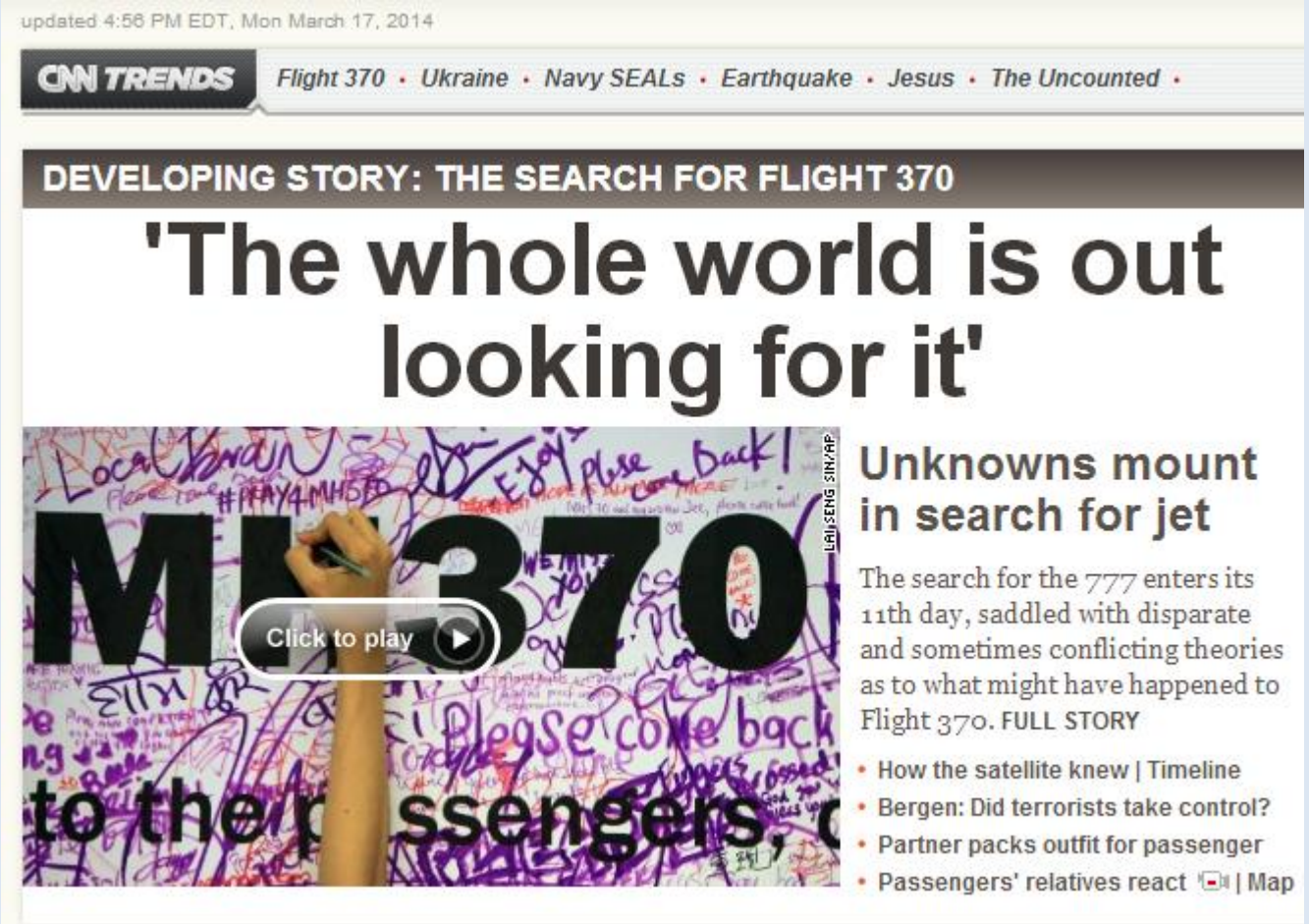
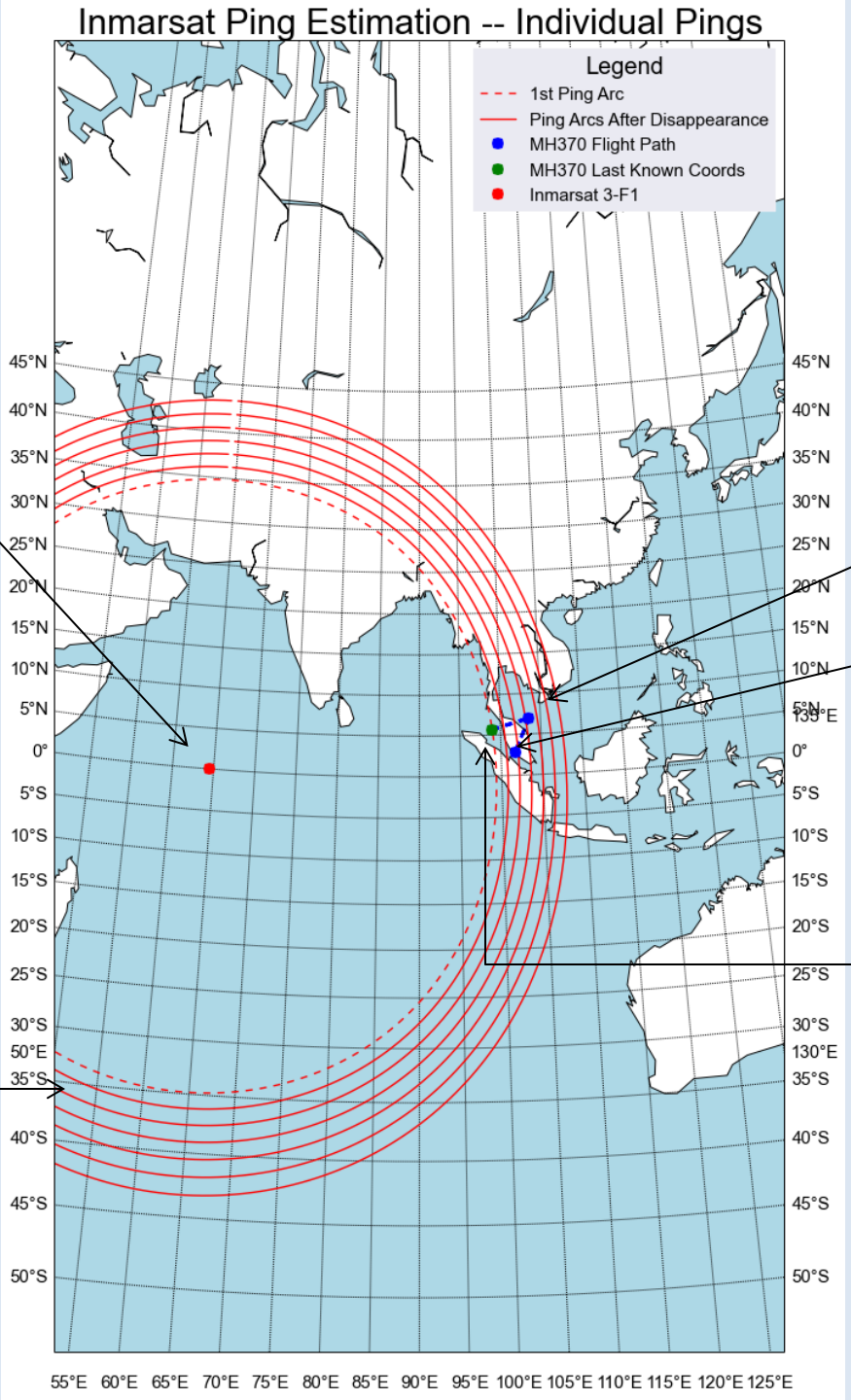
Modeling the Disappearance of MH370



Conor Myhrvold and Soren Larson

HARVARD
School of Engineering and Applied Sciences



Inmarsat Geostationary Satellite

Satellite Ping Arcs

Igari Waypoint

Kuala Lumpur

Pulau Perak

Institute for
Applied Computational Science
HARVARD SCHOOL OF ENGINEERING AND APPLIED SCIENCES

AM207 Schedule Syllabus Policies Resources Contact Archives

AM207/APMA E-207

Advanced Scientific Computing: Stochastic Optimization Methods. Monte Carlo Methods for Inference and Data Analysis

Pavlos Protopapas

lectures

Lecture 20 about Gaussian Processes is now posted..

More »

labs

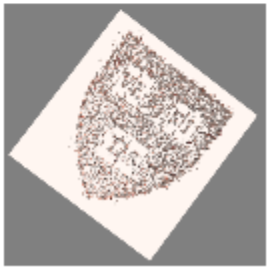
Notebook from tenth lab, on EM, etc has been posted..

More »

homeworks

HW10 is posted

More »



Monte Carlo methods are a diverse class of algorithms that rely on repeated random sampling to compute the solution to problems whose solution space is too large to explore systematically or whose systemic behavior is too complex to model. This course introduces important principles of Monte Carlo techniques and demonstrates the power of these techniques with simple (but very useful) applications. Starting from the basic ideas of Bayesian analysis and Markov chain Monte Carlo samplers, we move to more recent developments such as slice sampling, multi-grid Monte Carlo, Hamiltonian Monte Carlo, parallel tempering and multi-nested methods. We complete our investigation of Monte Carlo samplers with streaming methods such as particle filters/sequential Monte Carlo. Throughout the course we delve into related topics in stochastic optimization and inference such as genetic algorithms, simulated annealing, probabilistic Gaussian models, and Gaussian processes. Applications to Bayesian inference and machine learning are used throughout.

Class Material

- homeworks
- labs
- projects
- lectures

Class Links

- Piazza
- Videos
- ISite

Other Links

- Numpy
- Scipy
- Pandas
- Matplotlib
- PyMC3
- IAC5

HOME / PEOPLE /

Pavlos Protopapas

Scientific Program Director and Lecturer

Northwest B155

email course: AM 207

See also: IACS Lecturers, IACS Staff

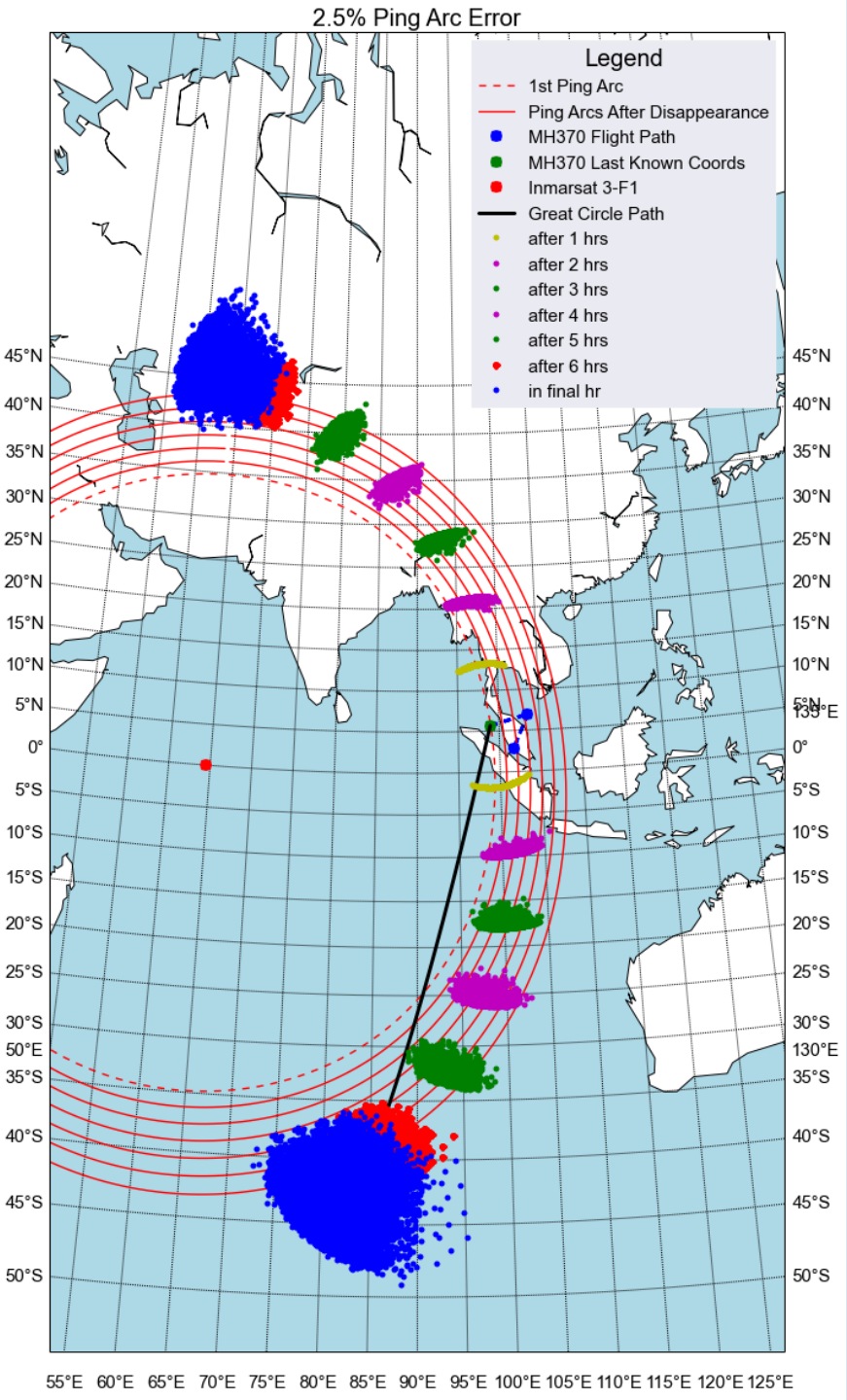
AM207 Final Project

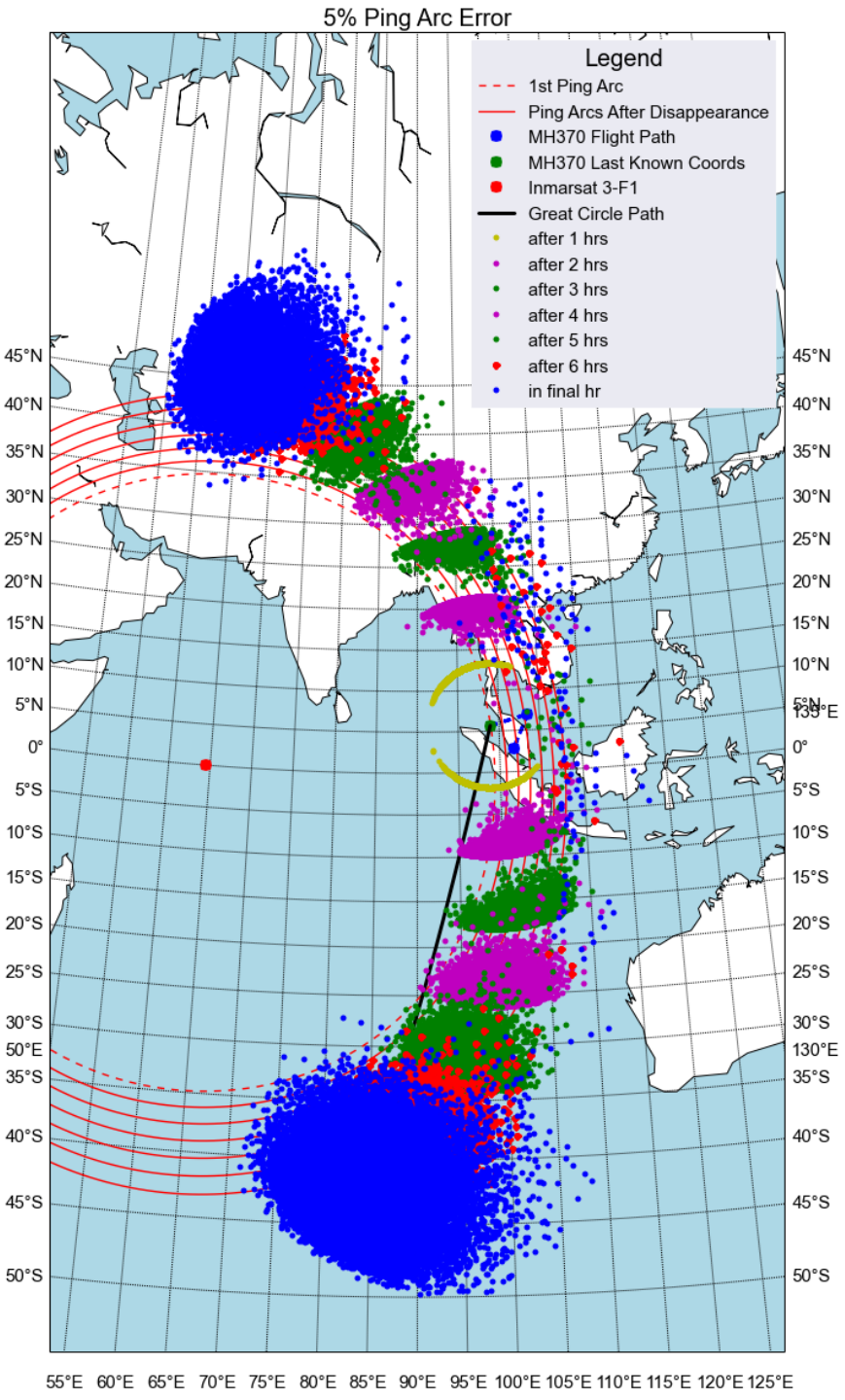
Part 1 Monte Carlo Model

Part 2 Hidden Markov Model

Part 3 Kalman Filter Model

A Few Examples…


2.5% Ping Arc Error
Legend
1st Ping Arc
Ping Arcs After Disappearance
MH370 Flight Path
MH370 Last Known Coords
Inmarsat 3-F1
Great Circle Path
after 1 hrs
after 2 hrs
after 3 hrs
after 4 hrs
after 5 hrs
after 6 hrs
in final hr
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
10°S
15°S
20°S
25°S
30°S
35°S
40°S
45°S
50°S
50°E
130°E
55°E 60°E 65°E 70°E 75°E 80°E 85°E 90°E 95°E 100°E 105°E 110°E 115°E 120°E 125°E


5% Ping Arc Error
Legend
1st Ping Arc
Ping Arcs After Disappearance
MH370 Flight Path
MH370 Last Known Coords
Inmarsat 3-F1
Great Circle Path
after 1 hrs
after 2 hrs
after 3 hrs
after 4 hrs
after 5 hrs
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45°N
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15°N
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5°N
0°
5°S
10°S
15°S
20°S
25°S
30°S
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45°S
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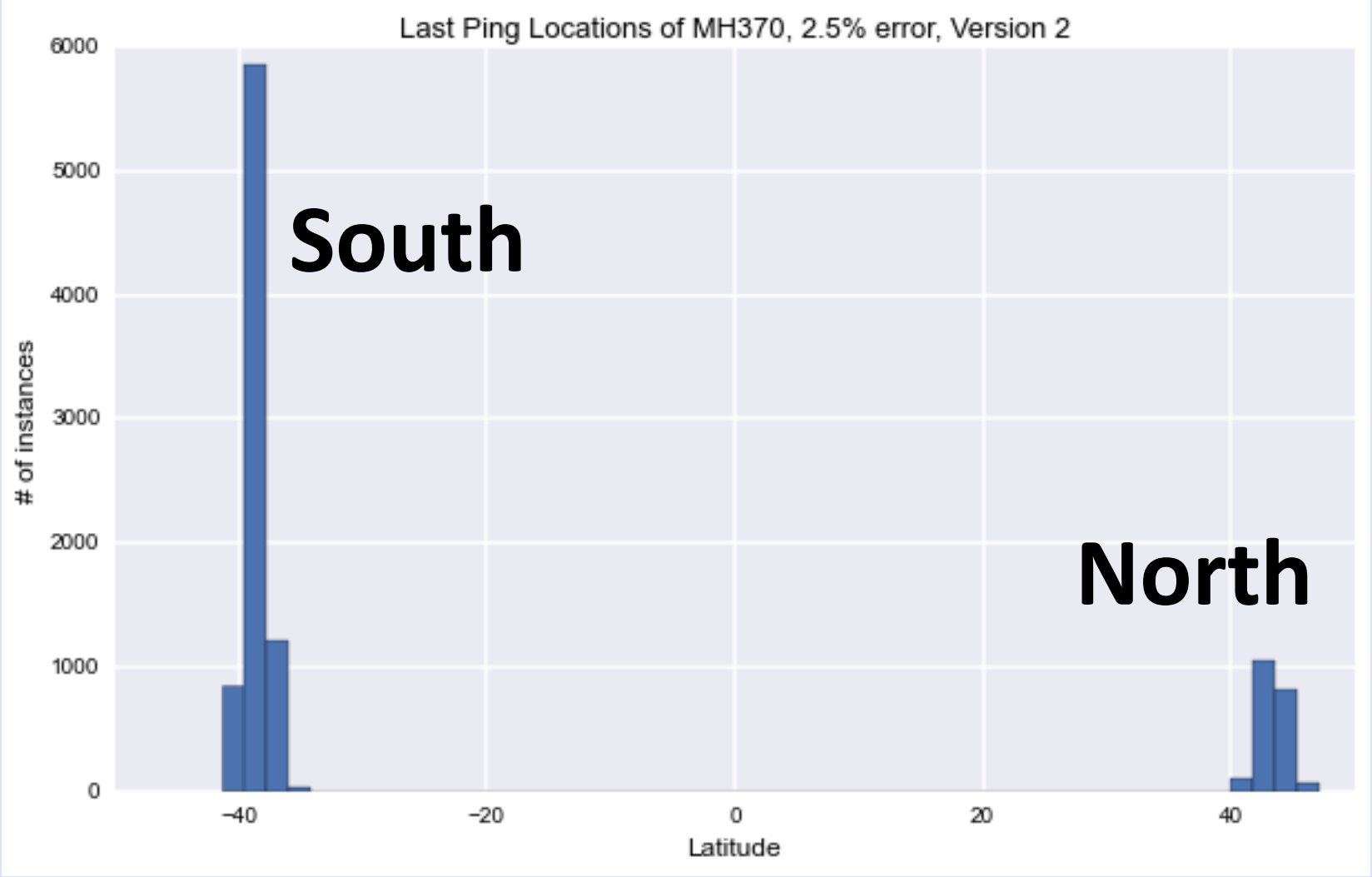
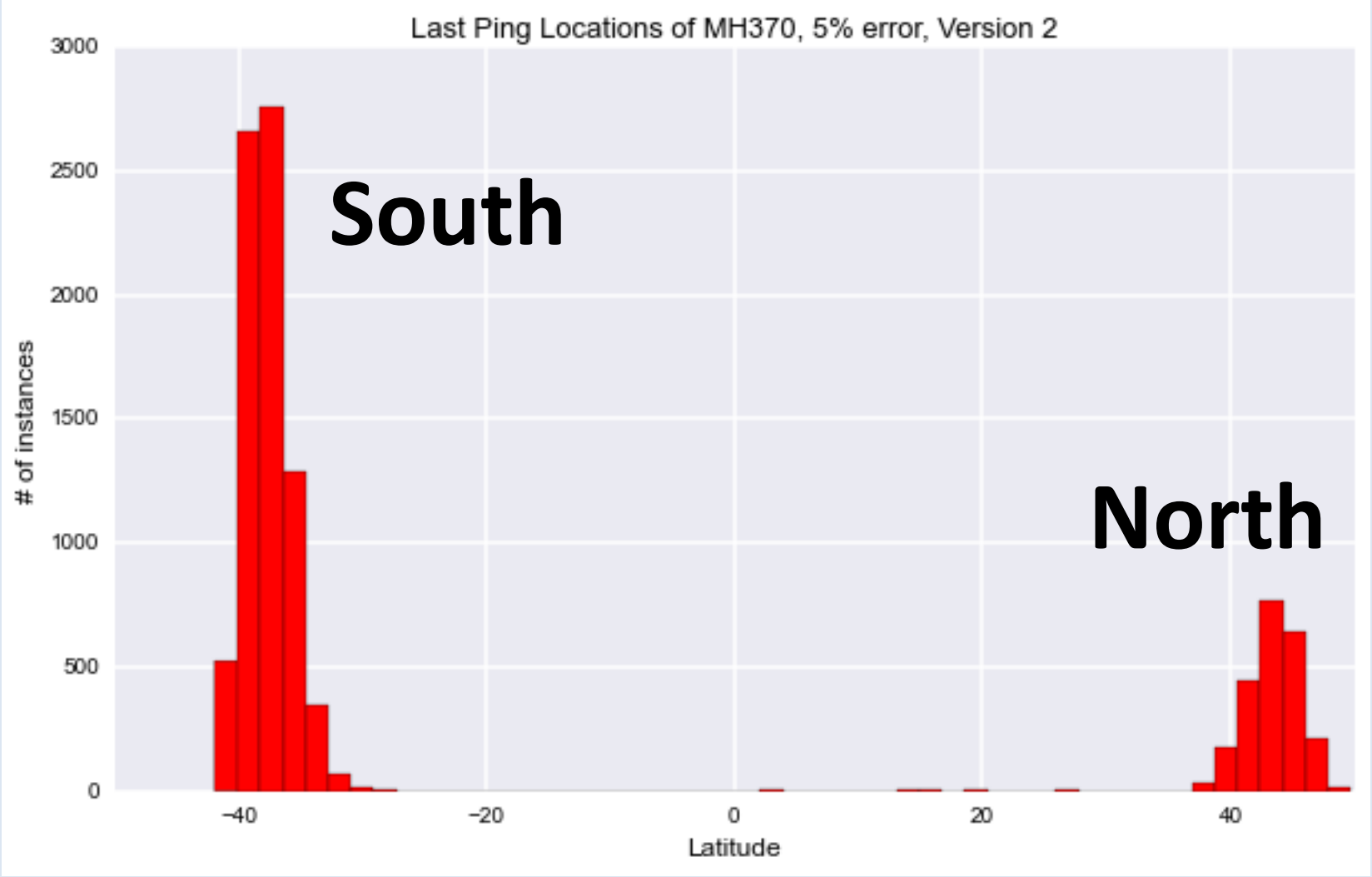
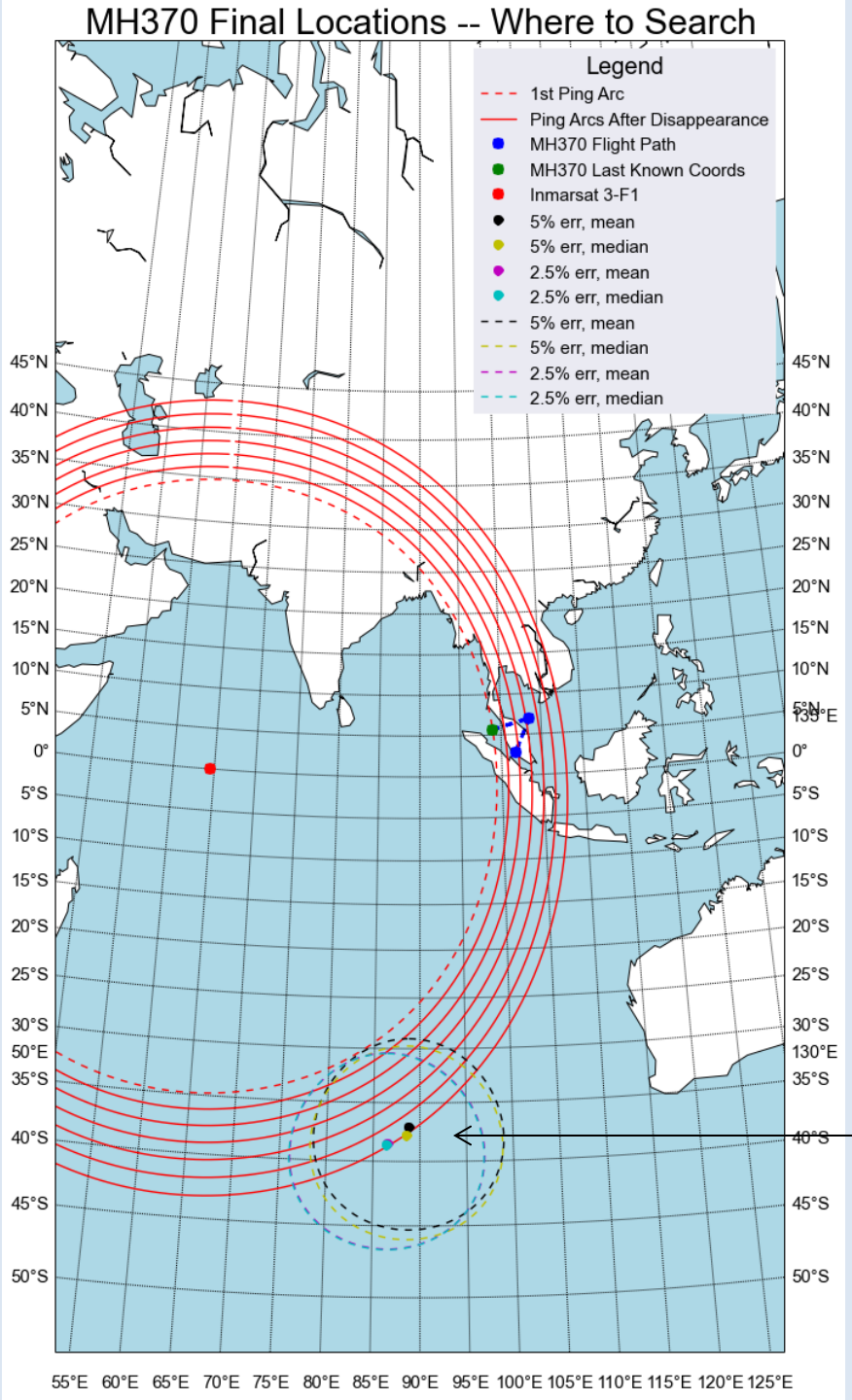
130°E
55°E 60°E 65°E 70°E 75°E 80°E 85°E 90°E 95°E 100°E 105°E 110°E 115°E 120°E 125°E


Last Ping Locations of MH370, 2.5% error, Version 2
6000
5000
4000
3000
2000
1000
0
# of instances
South
North
−40
−20
0
20
40
Latitude

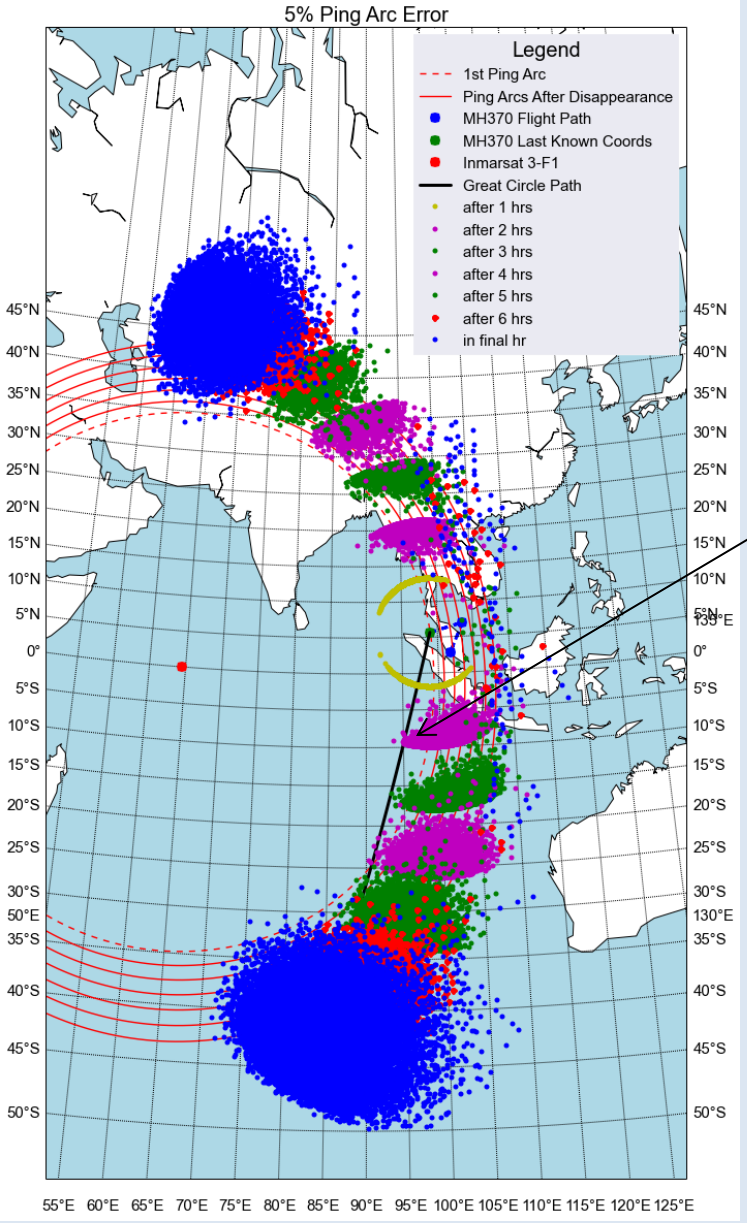

Last Ping Locations of MH370, 5% error, Version 2
South
North
# of instances
3000
2500
2000
1500
1000
500
0
−40
−20
0
20
40
Latitude



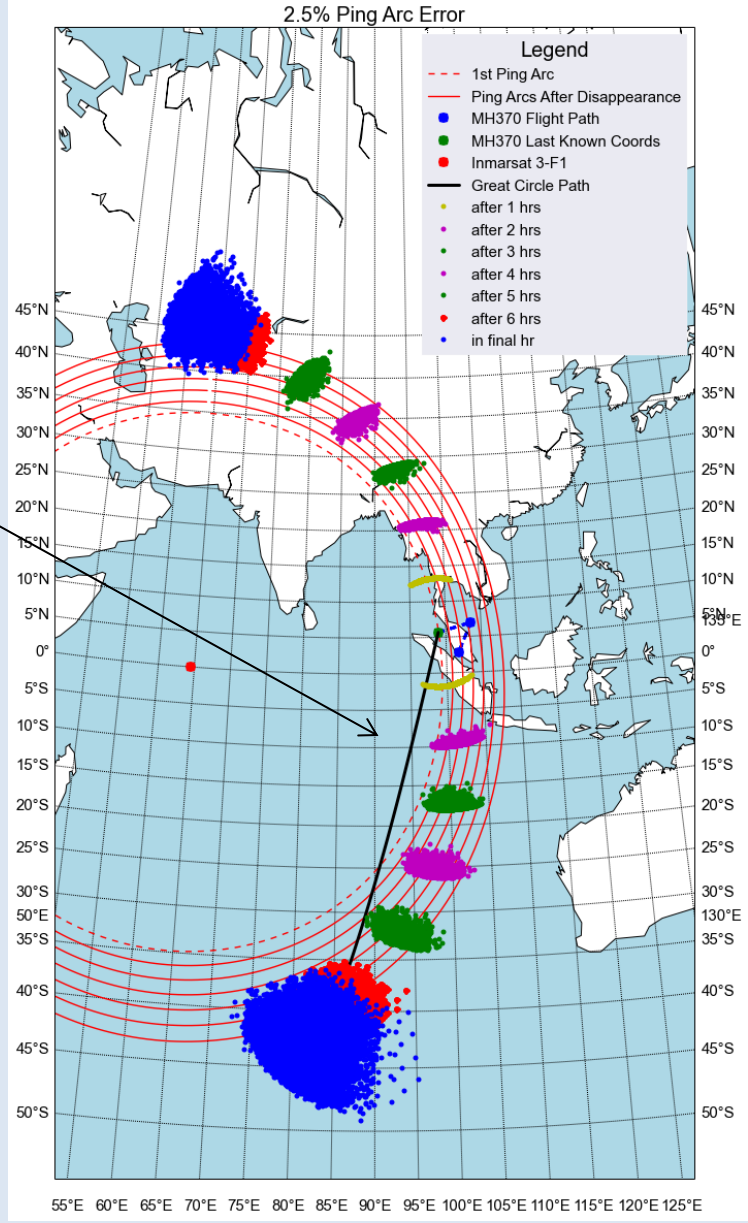
Average of South

Mean and median

2.5% and 5% ping arc error



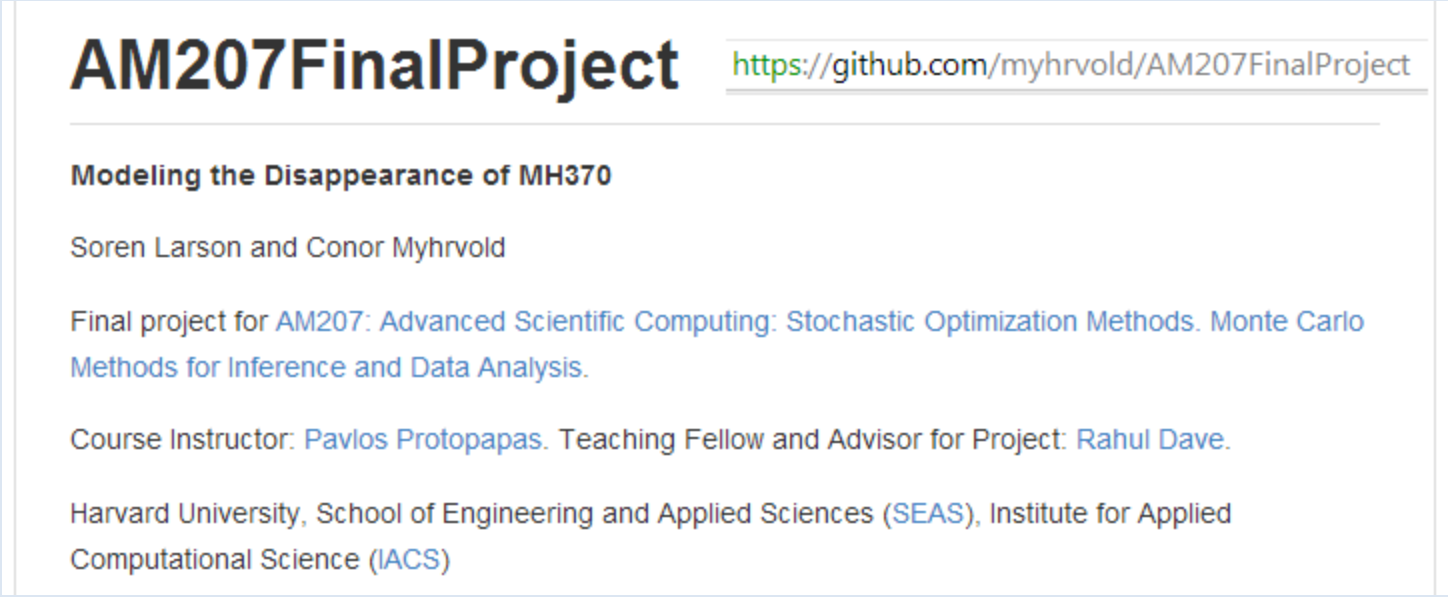
Great Circle Path to Final Location Area



To Explore More…

Website Landing Page

https://github.com/myhrvold/AM207FinalProject



AM207FinalProject

https://github.com/myhrvold/AM207FinalProject

Modeling the Disappearance of MH370

Soren Larson and Conor Myhrvold

Final project for AM207: Advanced Scientific Computing: Stochastic Optimization Methods. Monte Carlo Methods for Inference and Data Analysis.

Course Instructor: Pavlos Protopapas. Teaching Fellow and Advisor for Project: Rahul Dave.

Harvard University, School of Engineering and Applied Sciences (SEAS), Institute for Applied Computational Science (IACS)