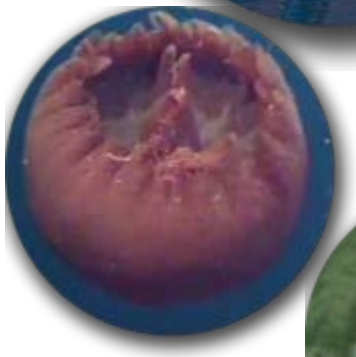


Gulf SERPENT and the MC252 Spill

Mark C. Benfield

Louisiana State University

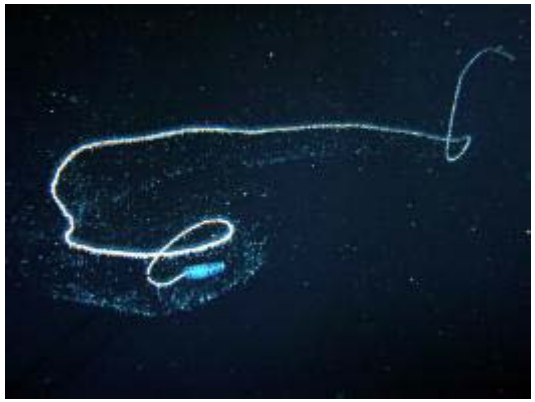
Oceanography and Coastal Sciences

Overview

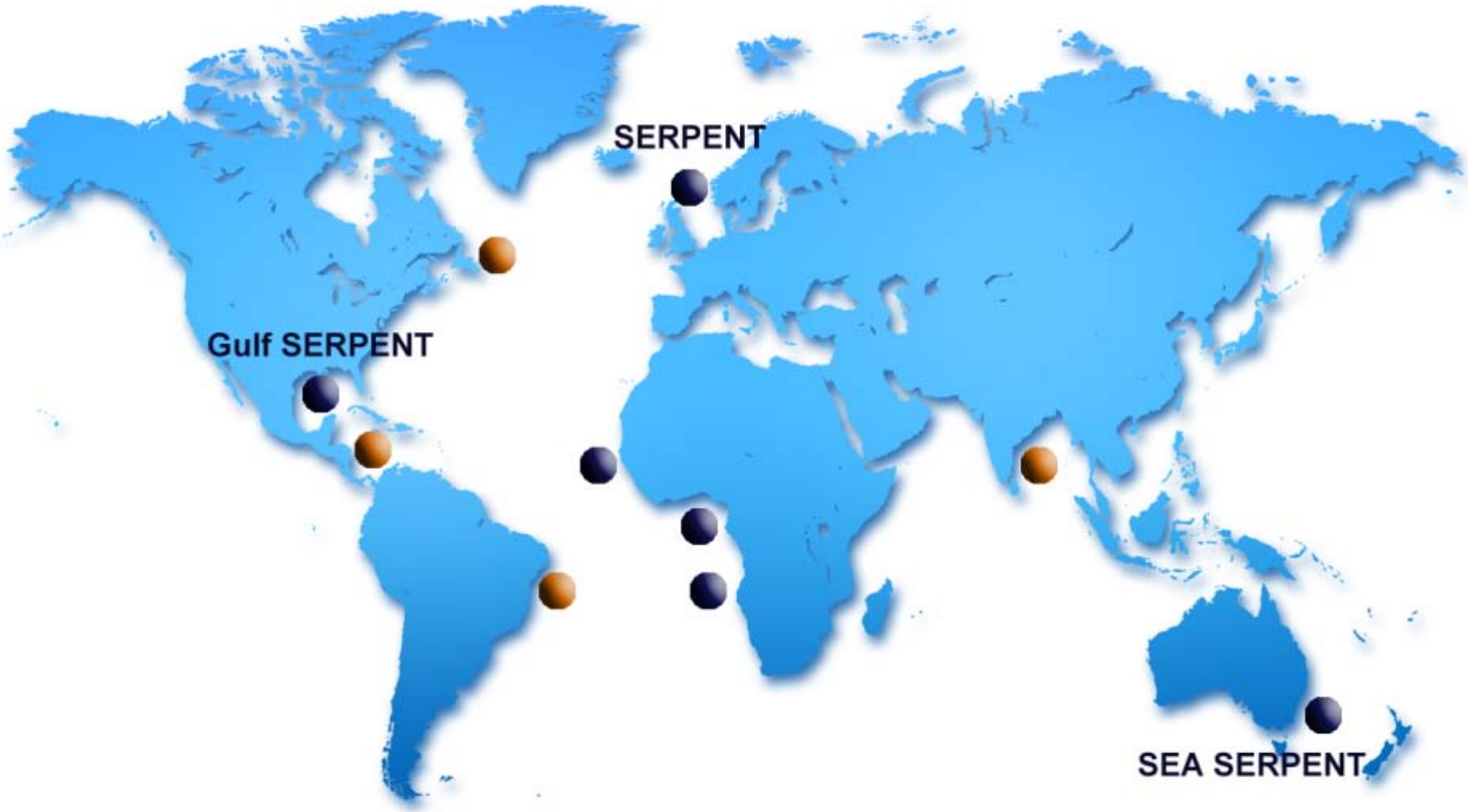
- Gulf SERPENT – Review
- Post-Spill Activities
- Improved Seafloor Survey Design

What is SERPENT?

- Global partnership between the oil and gas industry and academia
- ROVs and other instrumentation to conduct research
- Operational stand-by time
- Observations and experiments
- Pure and applied research
- Gulf SERPENT is directed towards understanding life in the mesopelagic and bathypelagic regions of the Gulf of Mexico



SERPENT Projects



Project Objectives

- Deep-sea biological observation system
- Mesopelagic and bathypelagic plankton and nekton
  - What organisms are present?
  - Where do they occur (lat, lon, depth)?
  - When do they occur?
  - What are they doing?

Value of SERPENT Data

- Funding from BOEMRE with in-kind match from BP and Shell
- Data from 2006 – early 2010 from a variety of sites in Mississippi Canyon including MC252
- Species presence/absence and vertical distribution
  - Not quantitative (numbers / m^3 or m^2)
- Mesopelagic and bathypelagic water column dominated by gelatinous and other invertebrate taxa

Post-Spill Activities

- Olympic Challenger ROV surveys around MC252

Post-Spill Activities

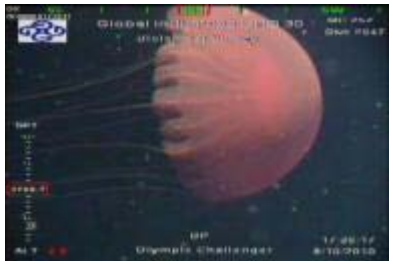
- Olympic Challenger ROV surveys around MC252
- Development Driller II water column and ROV surveys at MC252 #2

Post-Spill Activities

- Olympic Challenger ROV surveys around MC252
- Development Driller II water column and ROV surveys at MC252 #2
- Development Driller III ROV surveys around MC252

Olympic Challenger

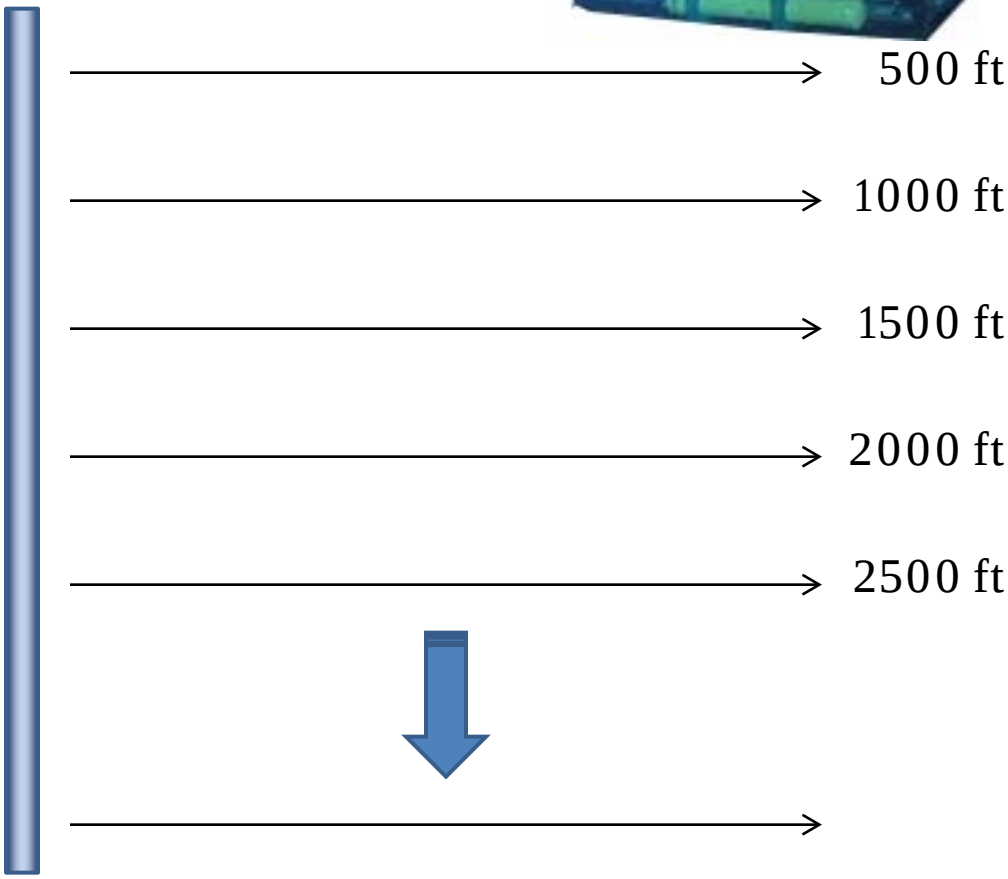
- Surveys of MC252 began in early August
- MV Olympic Challenger with two ROVs
- Water column surveys
- Seafloor/demersal surveys
- Five sites around BOP out to 2,000 m



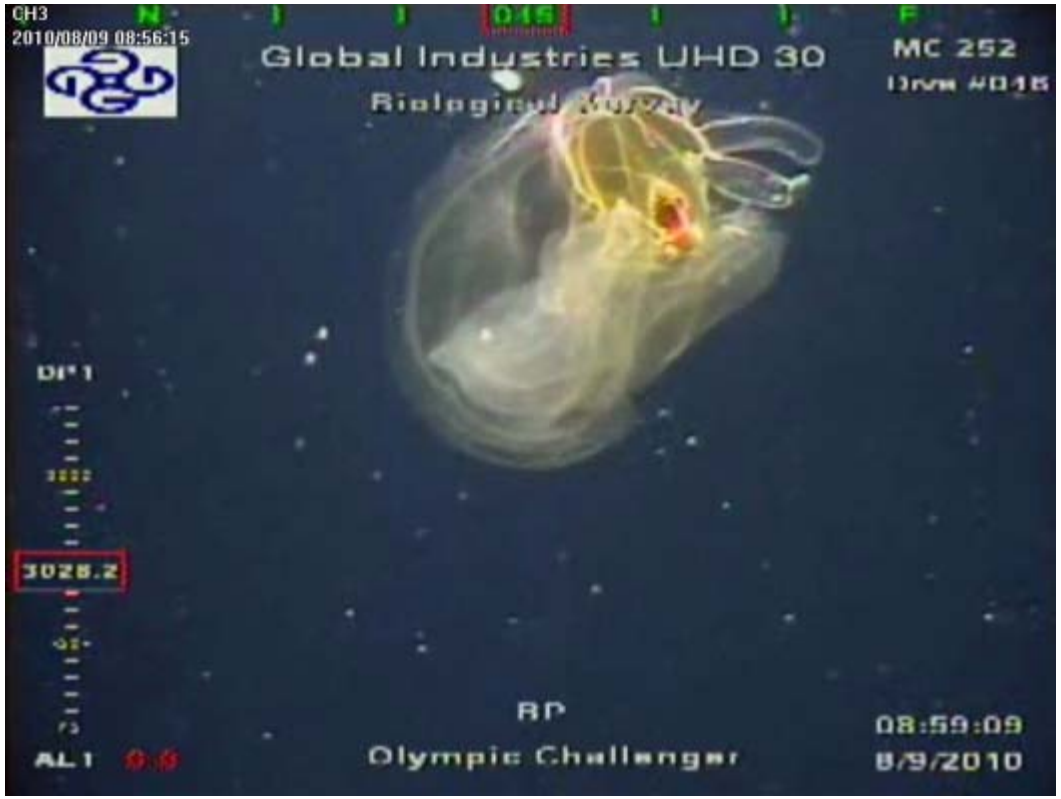
SURVEY LOCATIONS

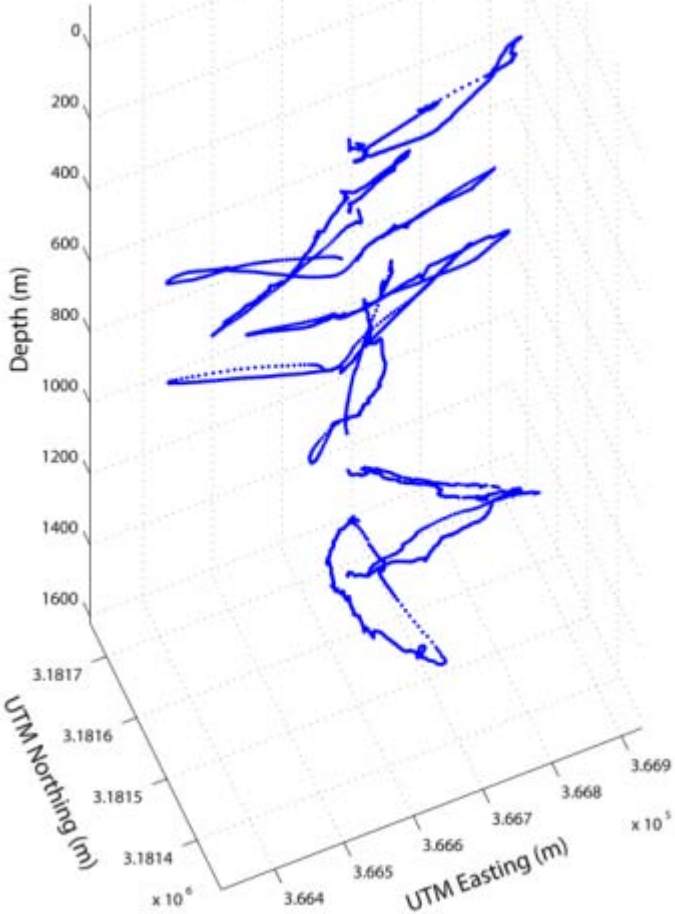
Gulf SERPENT Water Column Surveys

- Date, Time, Depth, Lat, Lon
- Behavior



Water Column Survey Example





PRELIMINARY RESULTS BASED ON INCOMPLETE ANALYSIS OF DATA

Example Water Column Fauna

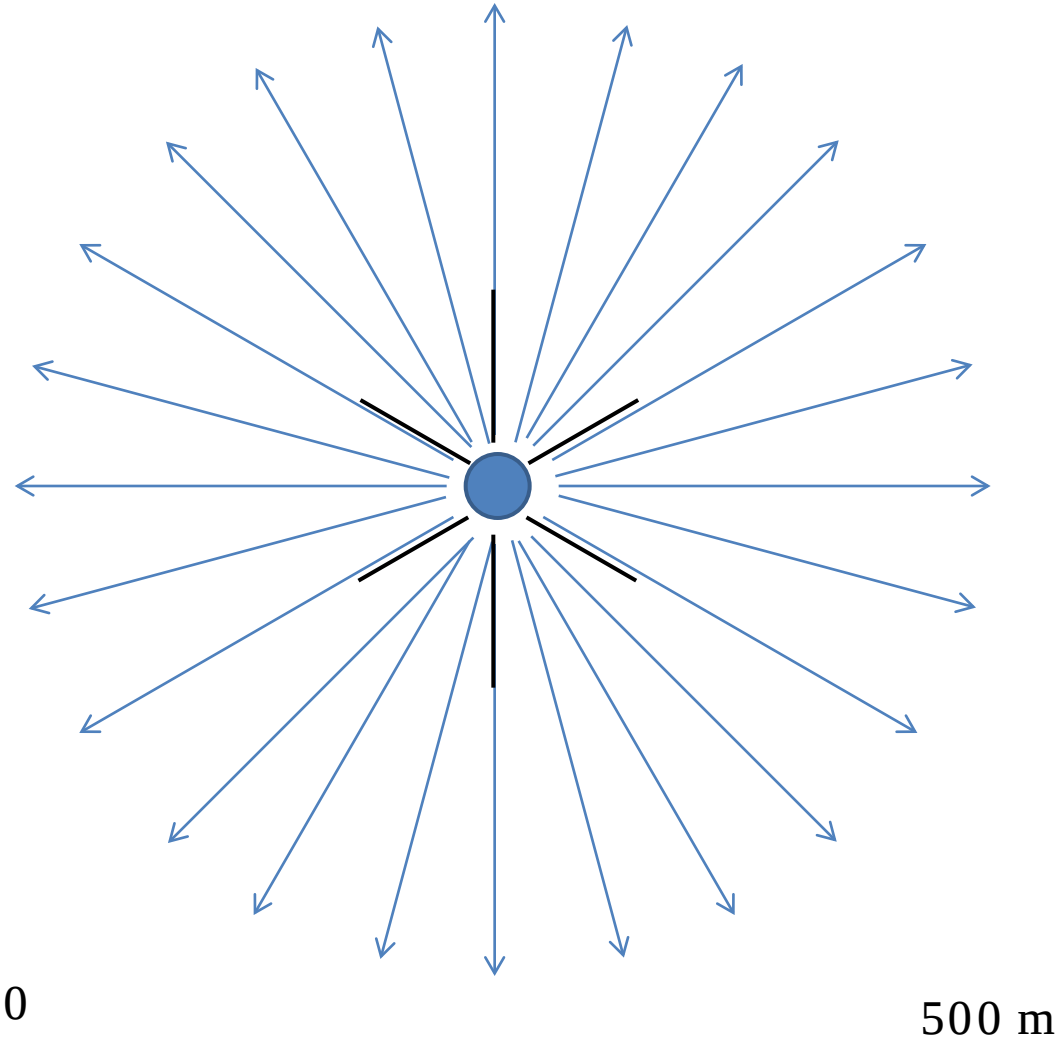
PRELIMINARY RESULTS BASED ON INCOMPLETE ANALYSIS OF DATA

Highlight

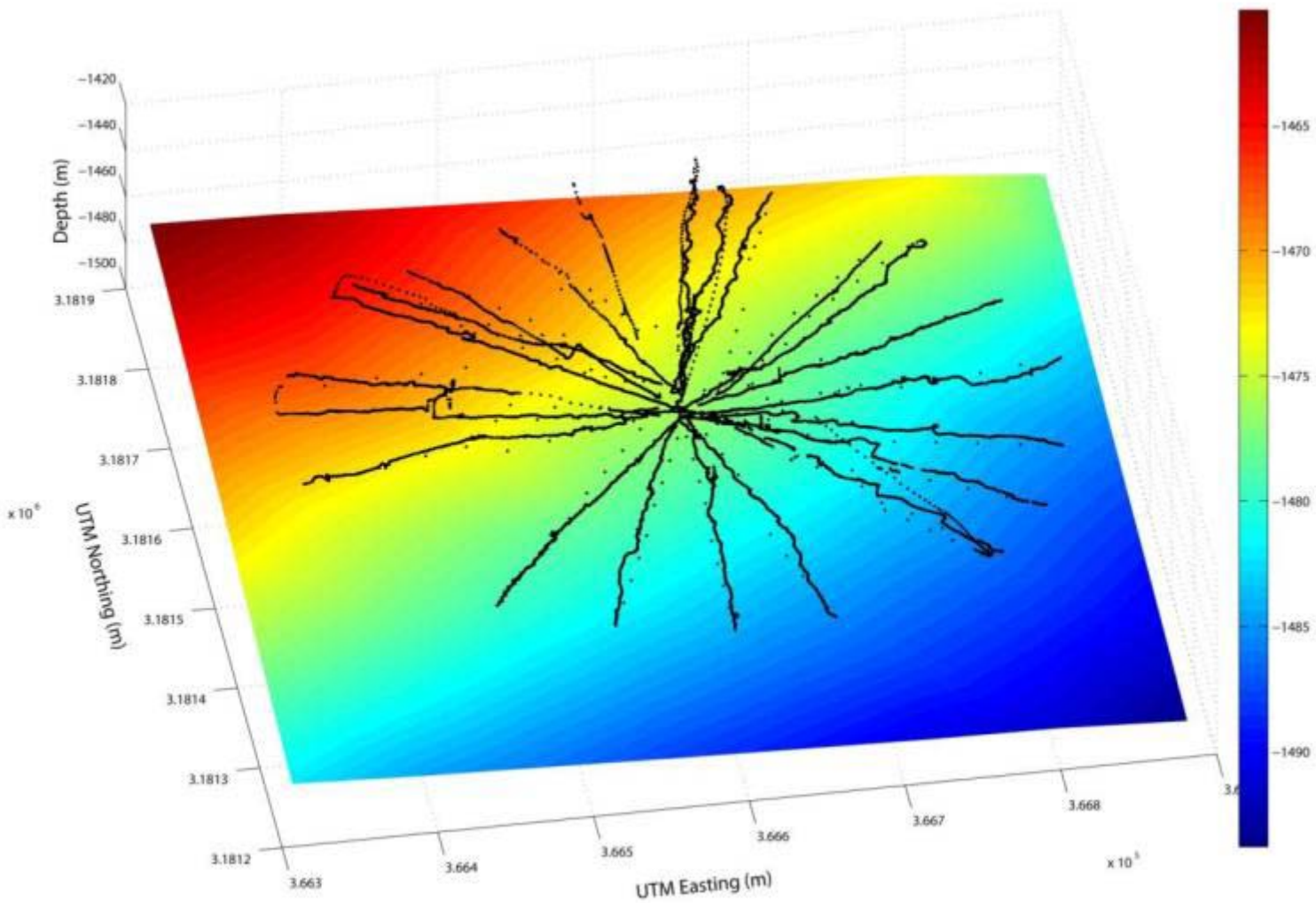
- Manefish (*Paracaristius* sp.)

Gulf SERPENT Sea Floor Surveys

- Radial 250 m transects on 15° bearings
- Contrast with BOEMRE Pre-Bottom surveys: 100 m @ 60° (NTL2008-G06)
- Most effective when used in conjunction with subsea navigation



Example Seafloor Survey: 2,000 m North of BOP



PRELIMINARY RESULTS BASED ON INCOMPLETE ANALYSIS OF DATA

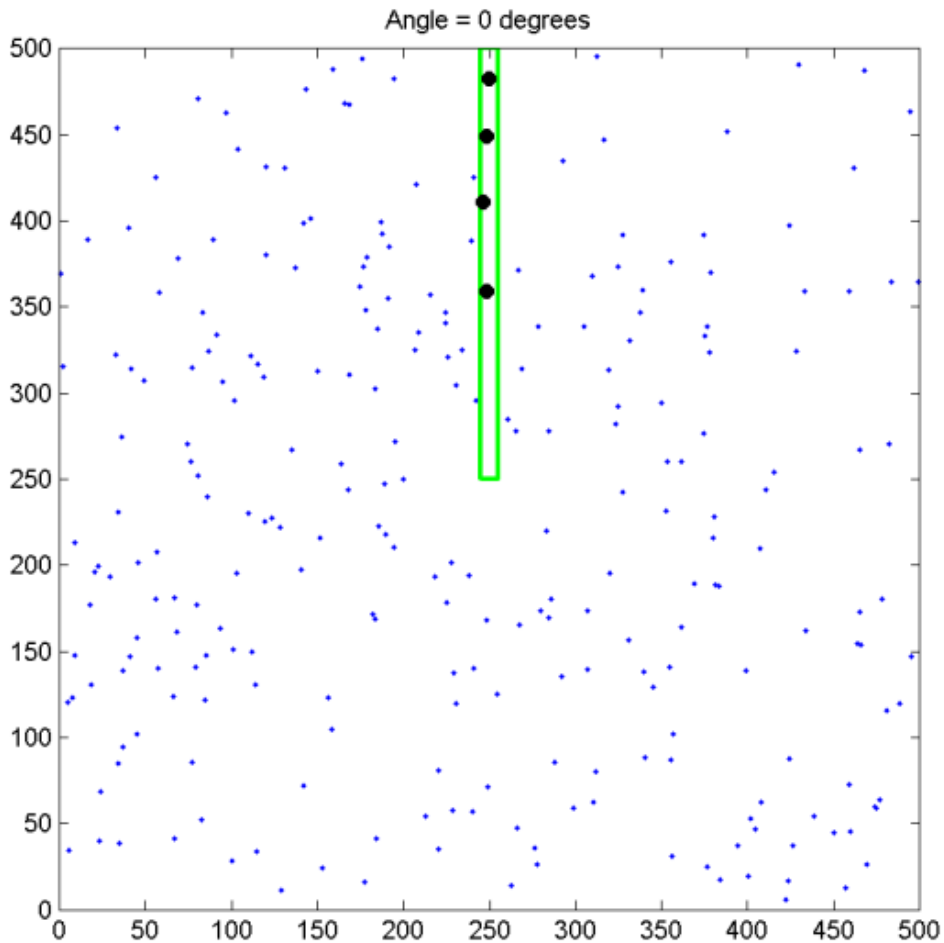
Why is a Different Design Needed?

- We need to be able to estimate the distribution and abundance of marine life (megafauna) with sufficient accuracy (limited error) to detect changes
- Simulation experiments suggest that the existing BOEMRE methodology has insufficient power to detect small changes in abundance

Evaluation of New Survey Design

- Matlab simulation within 500 m x 500 m domain
- Random distributions of organisms at densities of 0.0001 – 0.004 m^{-2}
- Sampled with twenty four 250 m long x 10 m wide video transects on bearings of 0, 15, 30, 45, ... 345°
- Density per transect averaged among transects and compared with true mean for the entire domain
- Note: for computational ease, fixed transect and rotated domain at 15° increments

Simulation Example: Density = 0.001 m^{-2}



The animals are indicated by small blue dots, the transect is delineated by a green box, and all animals that are within each transect are highlighed as larger black dots. Note the domain is rotating counter clockwise relative to the transect.

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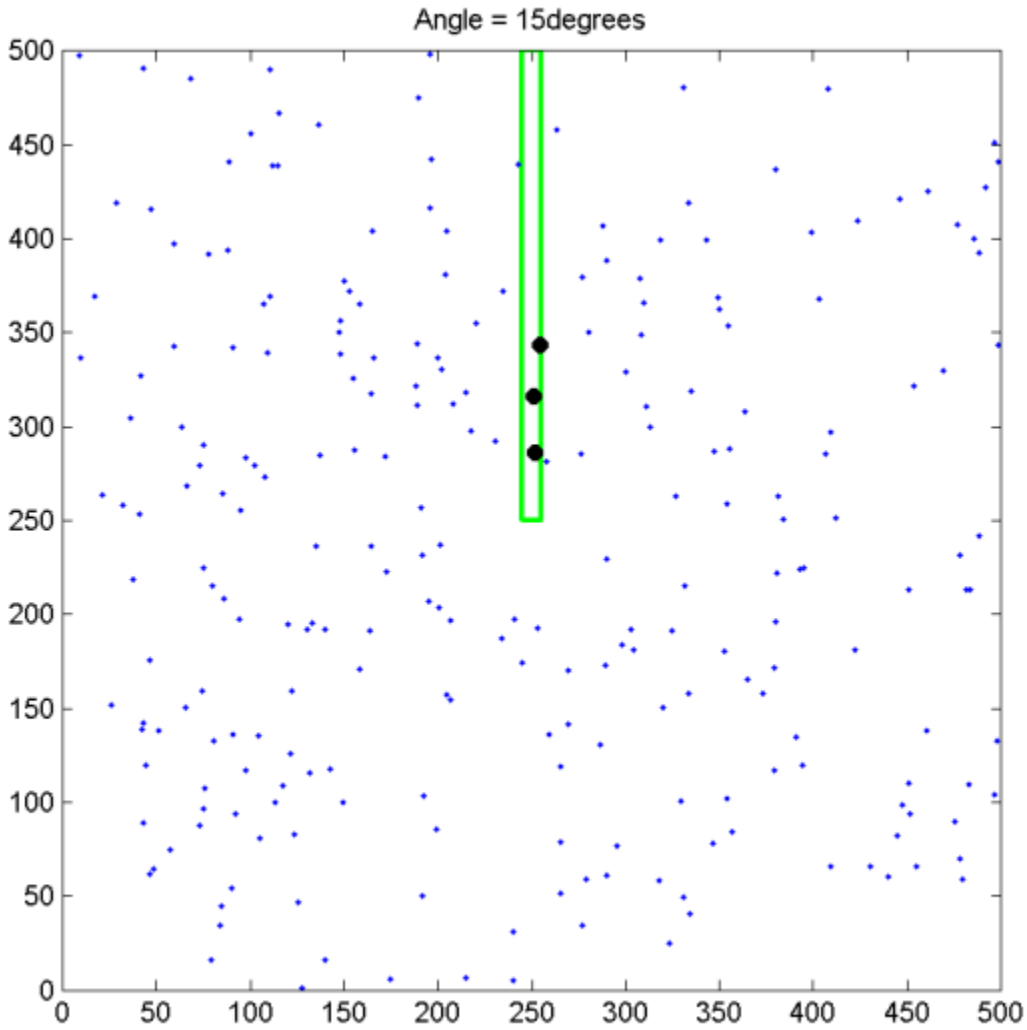

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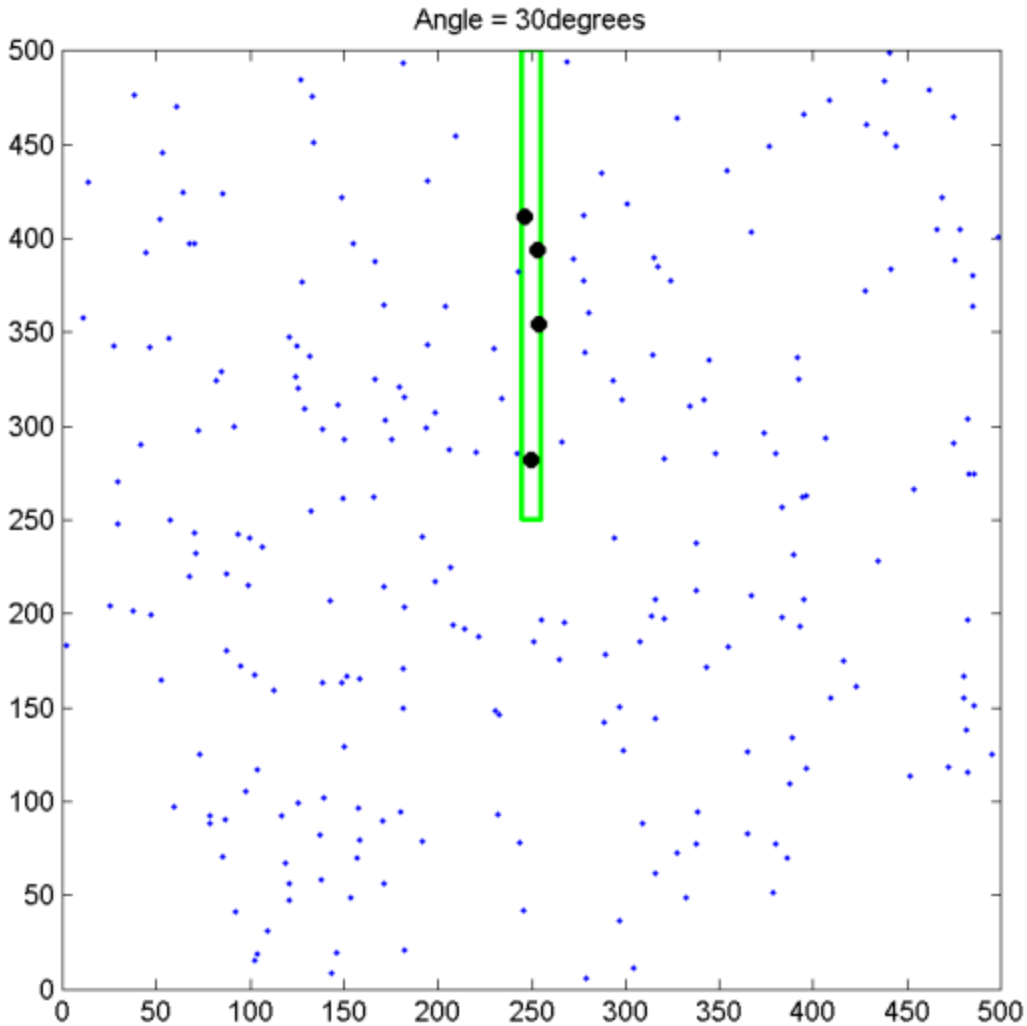

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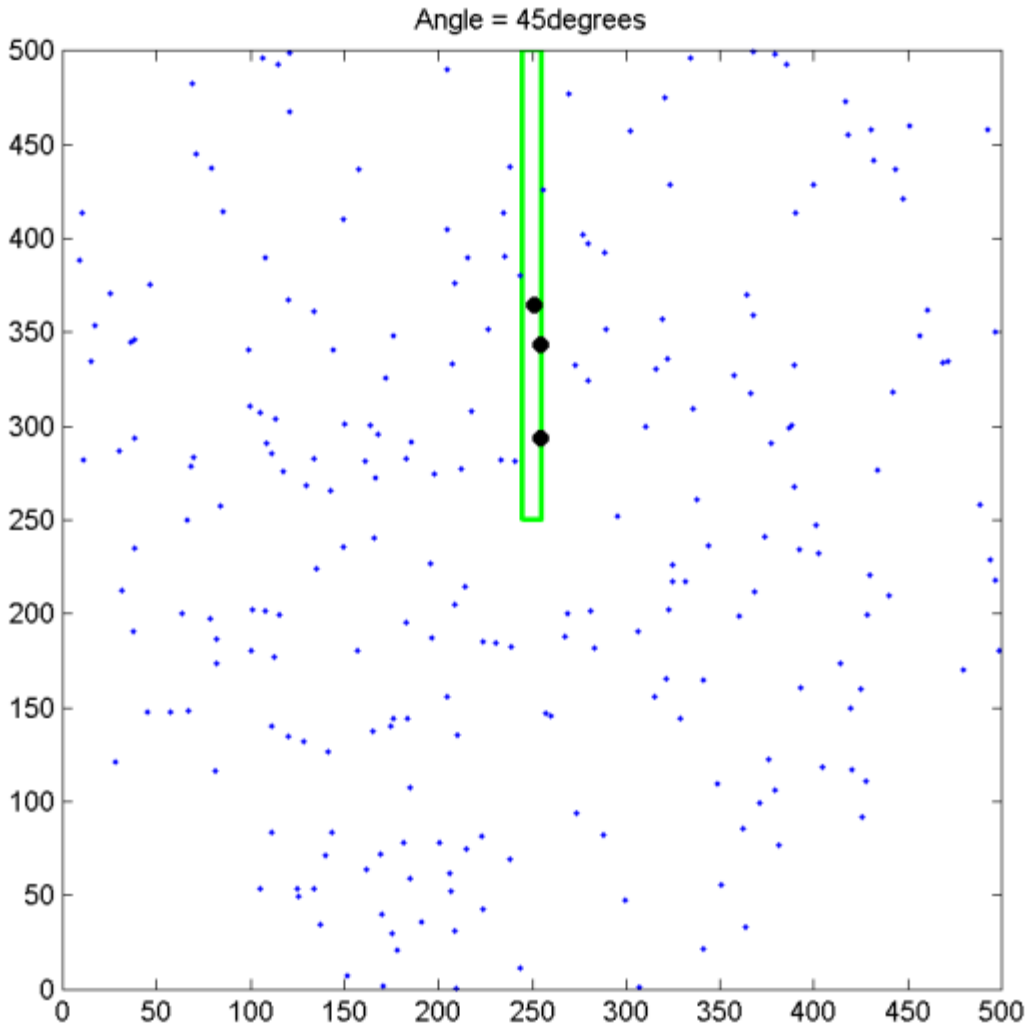

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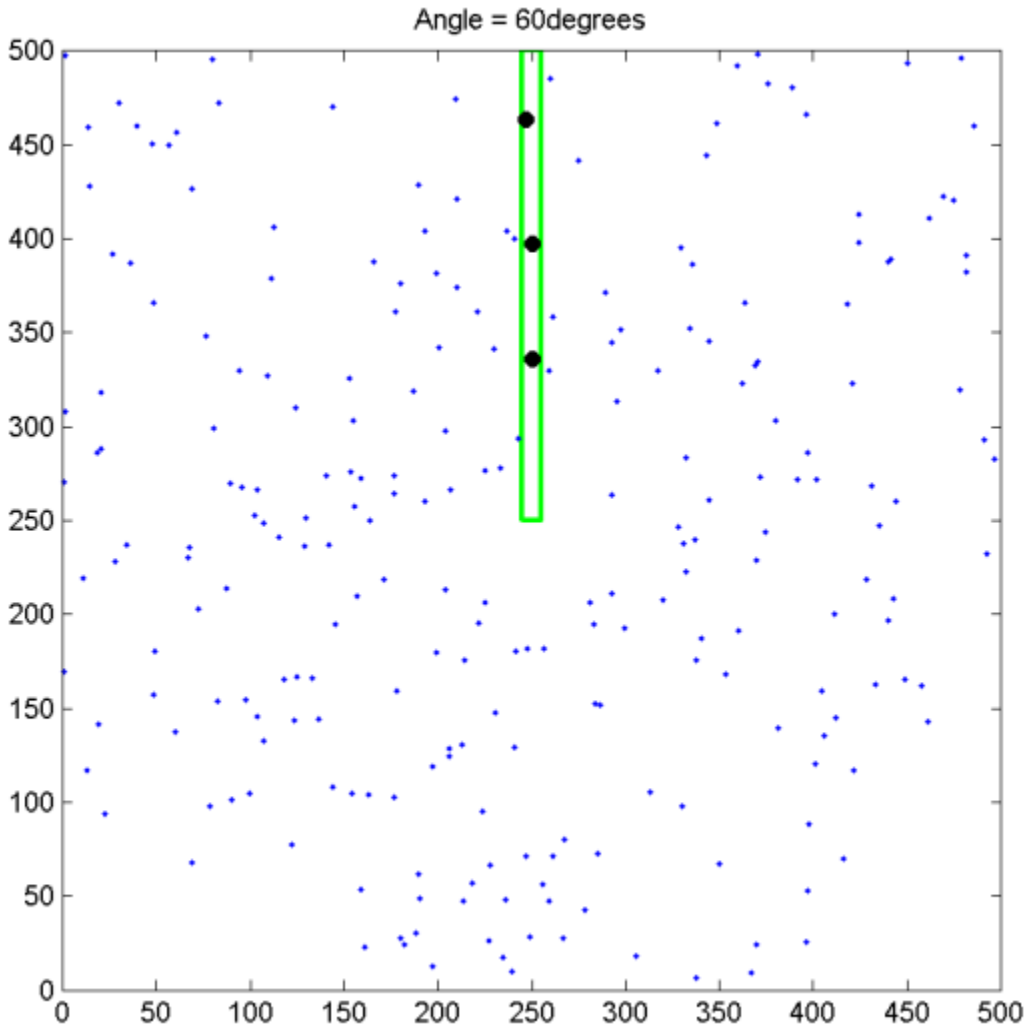

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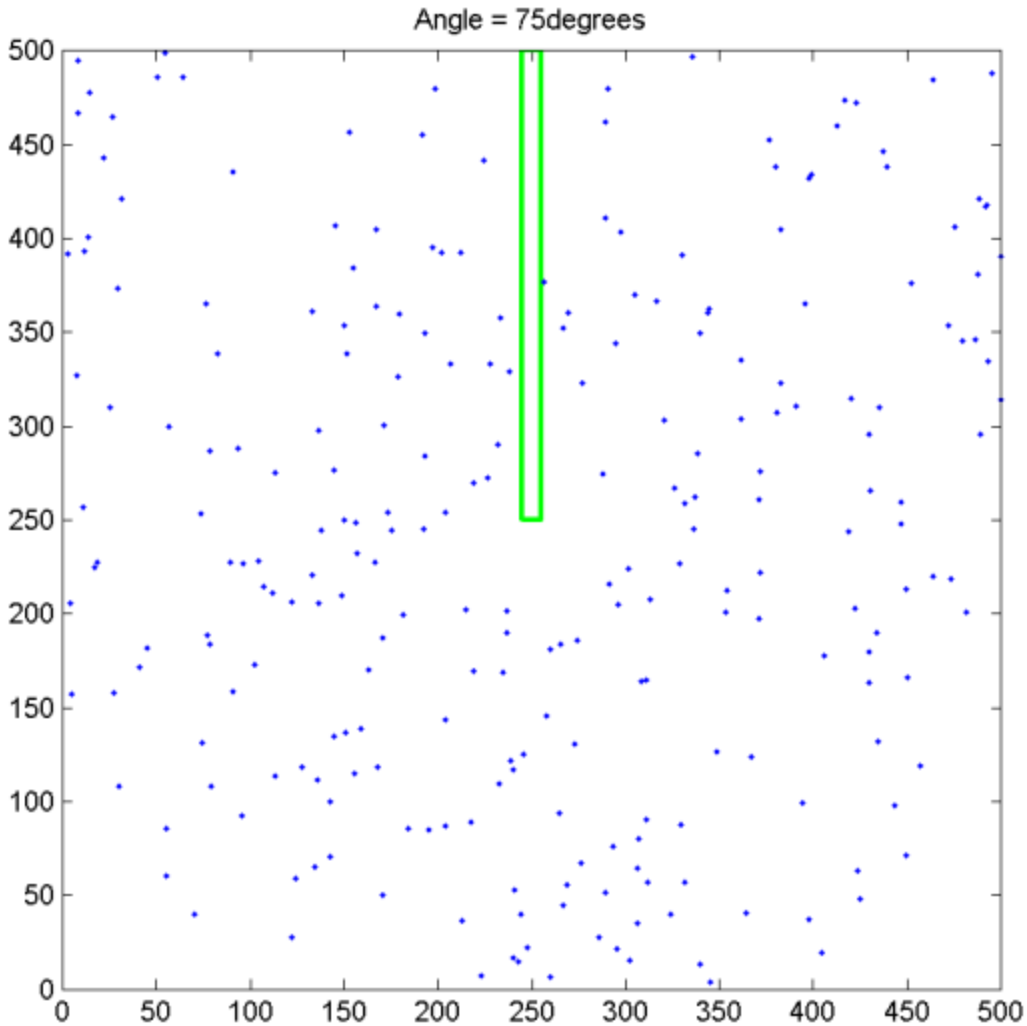

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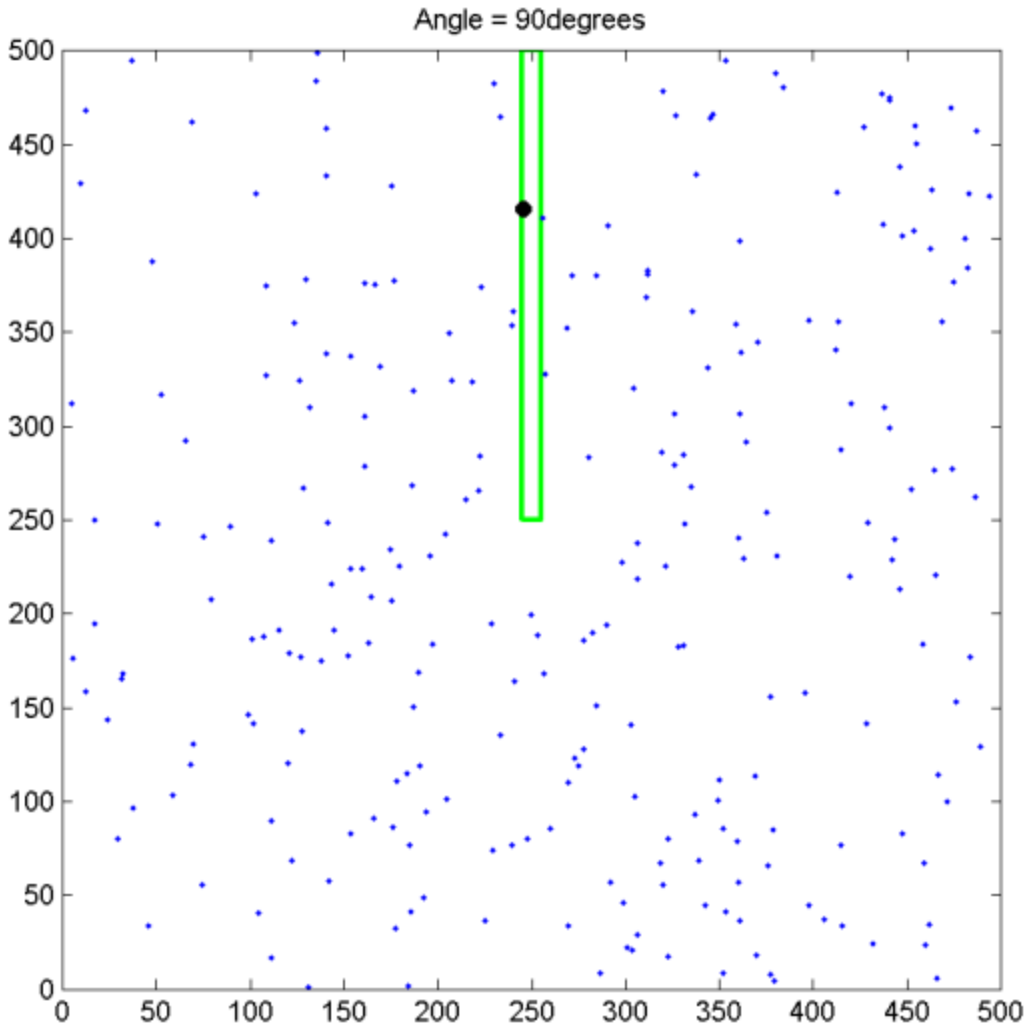

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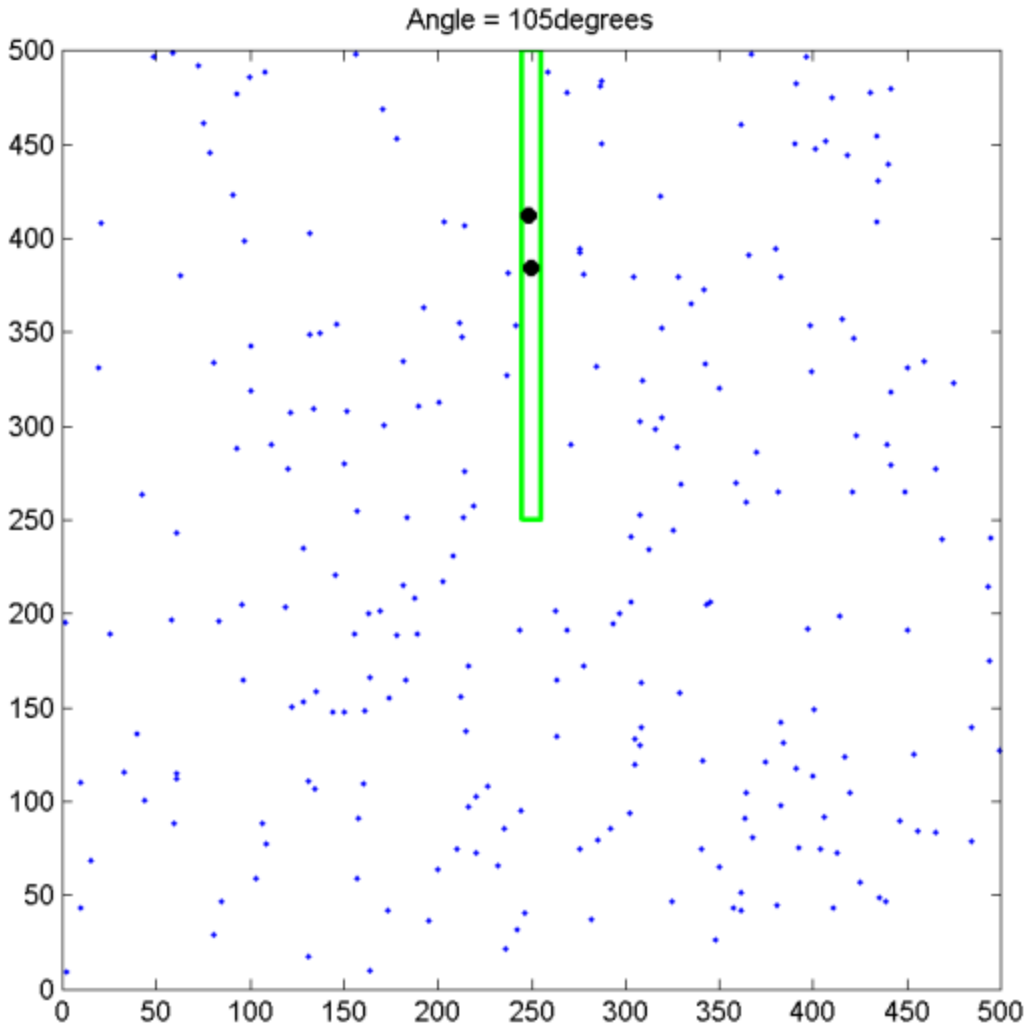

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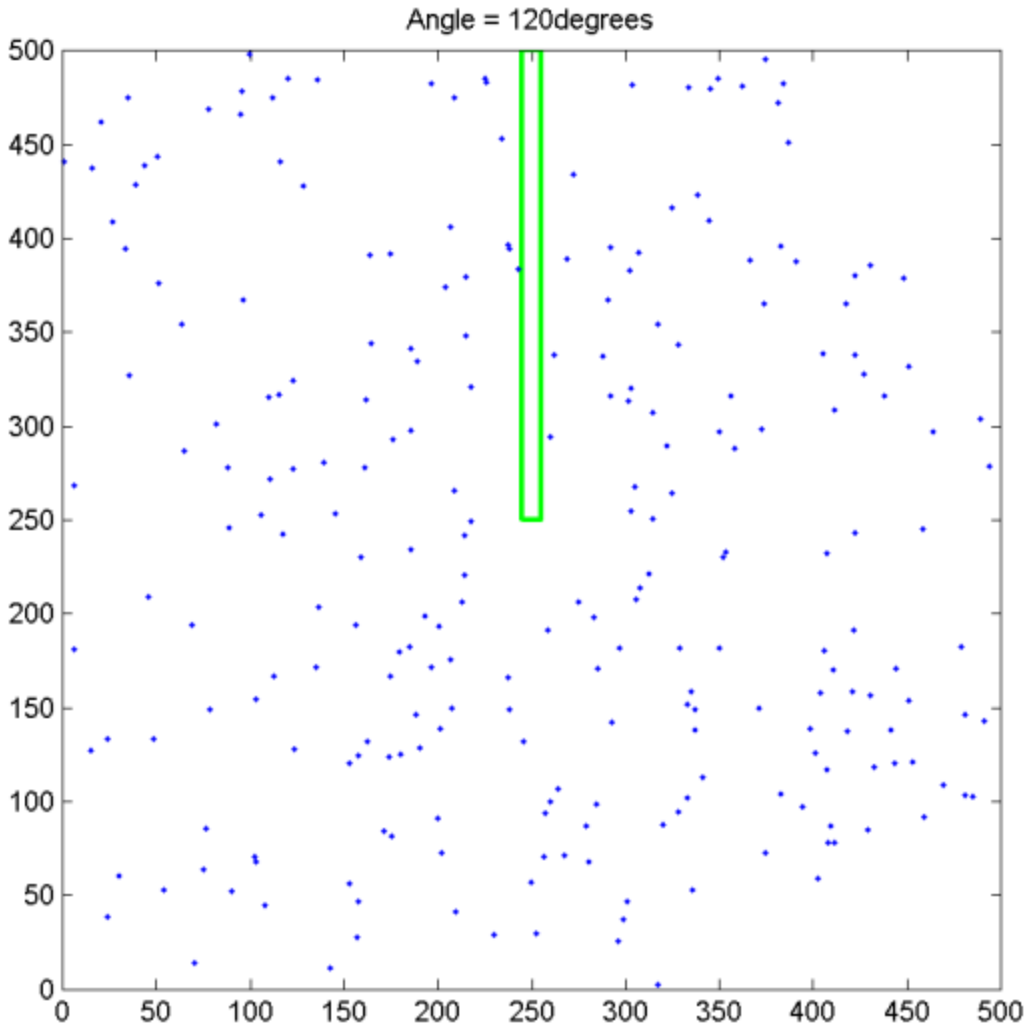

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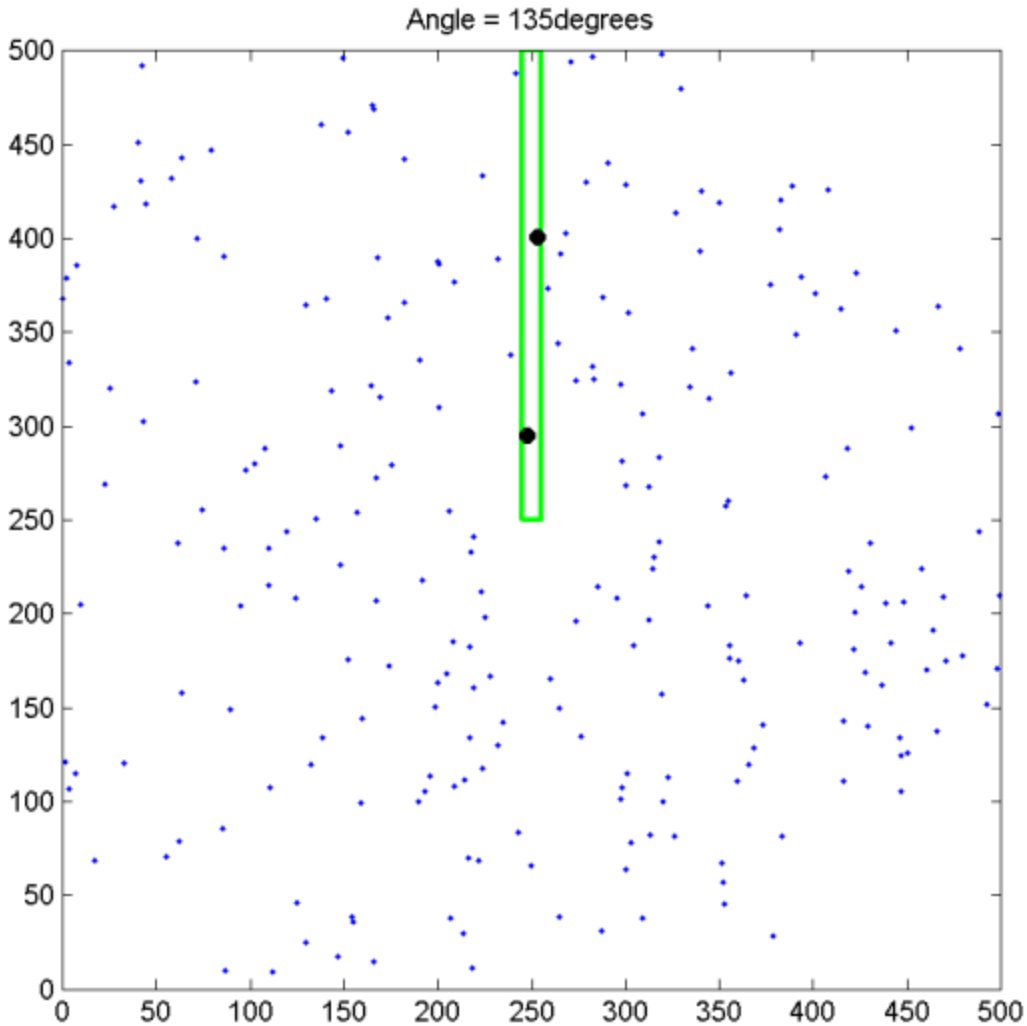

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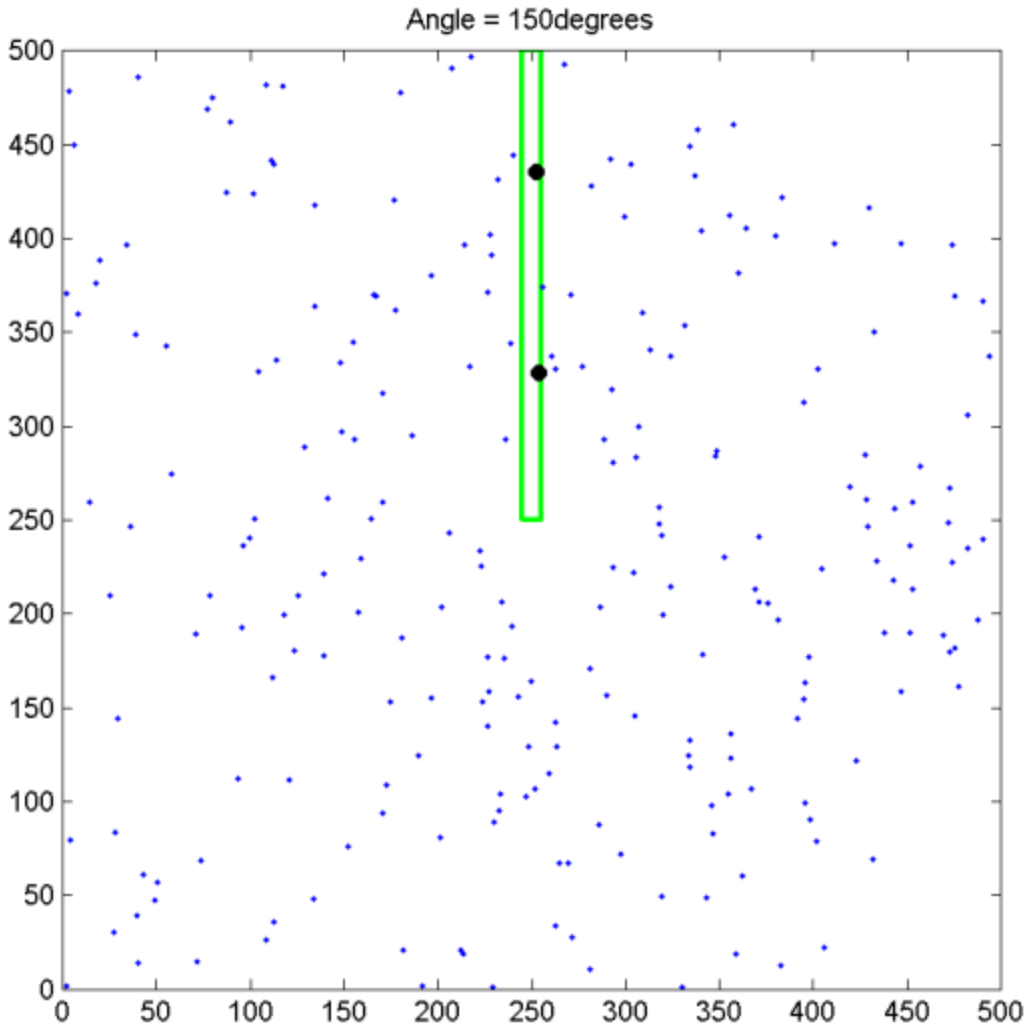

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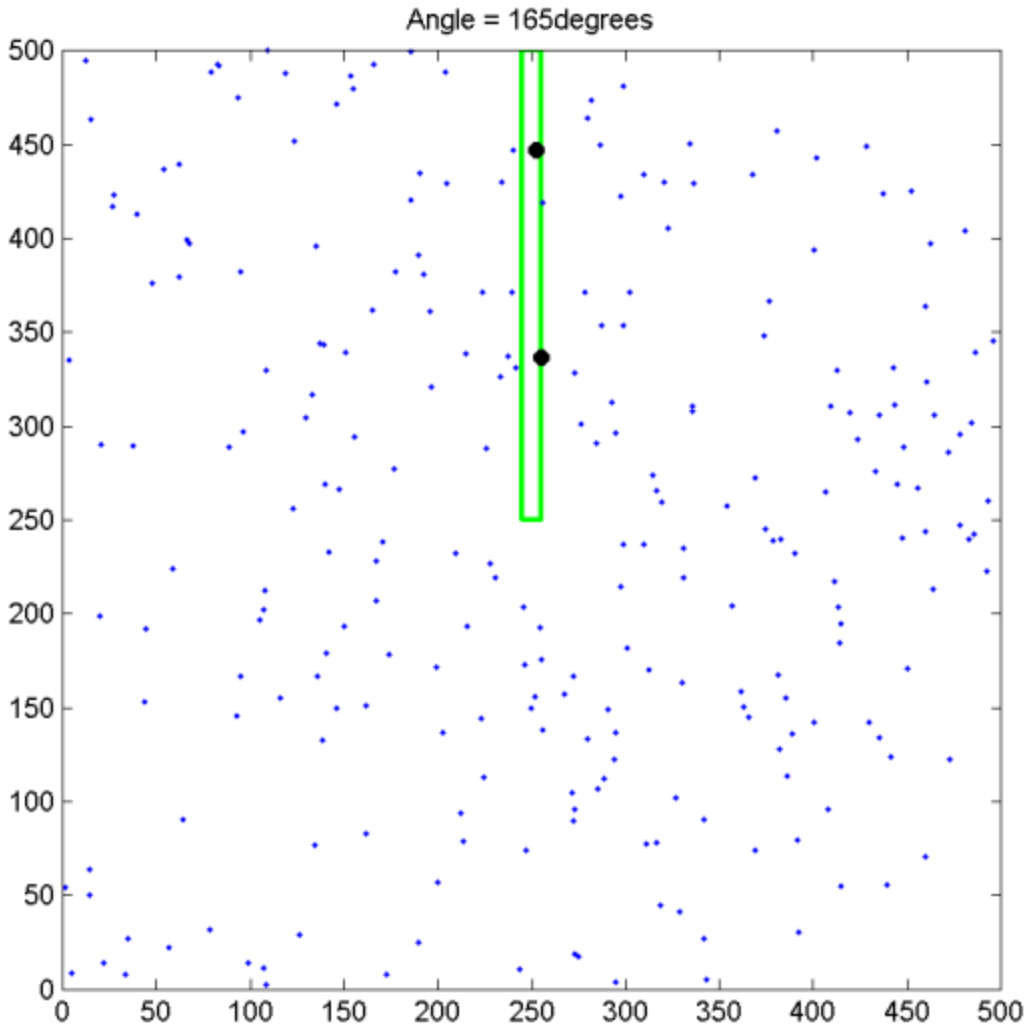

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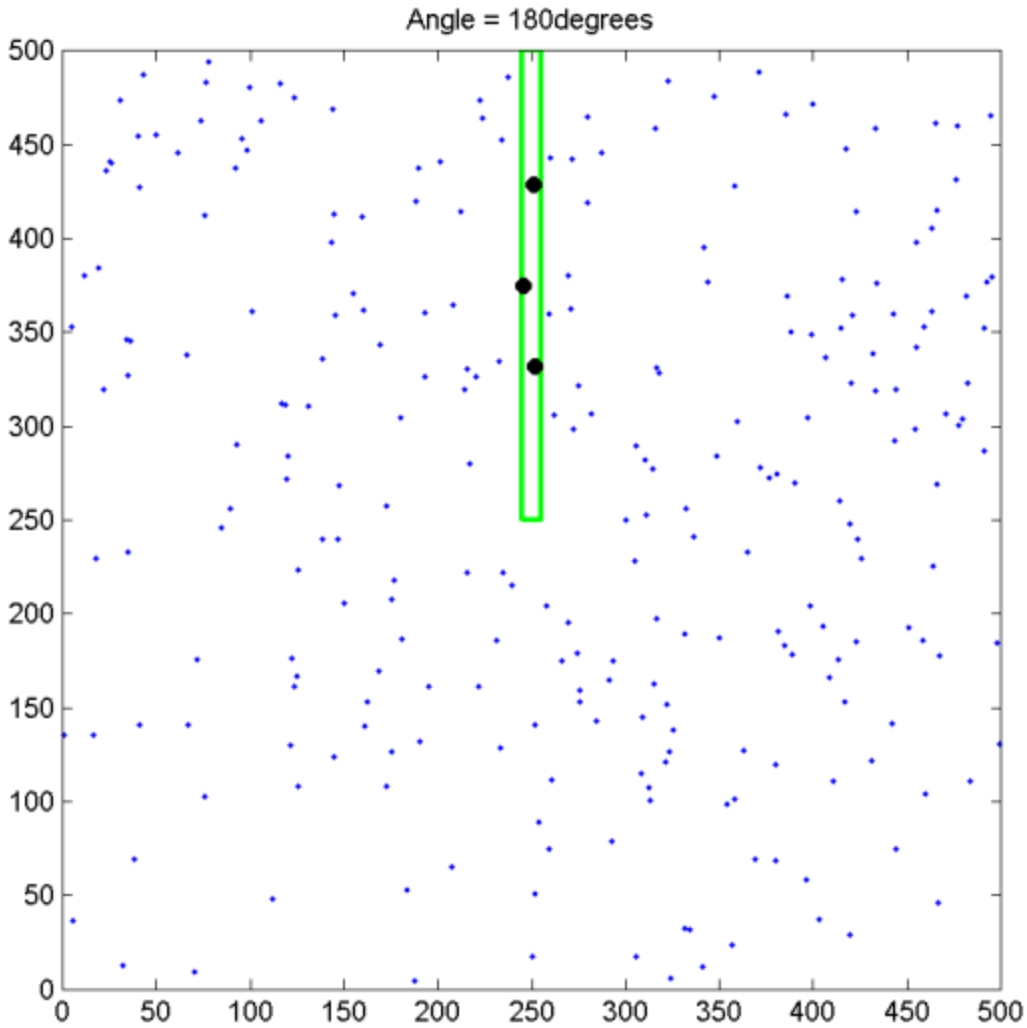

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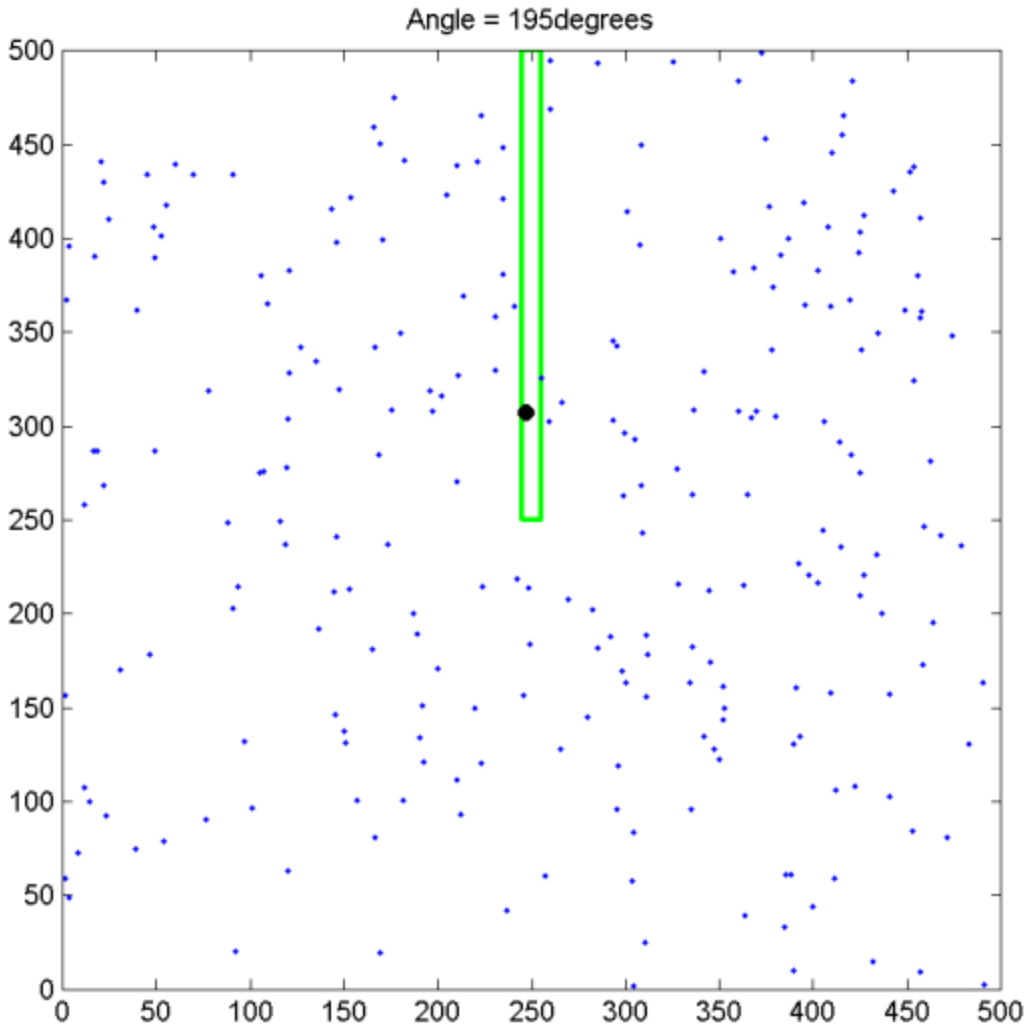

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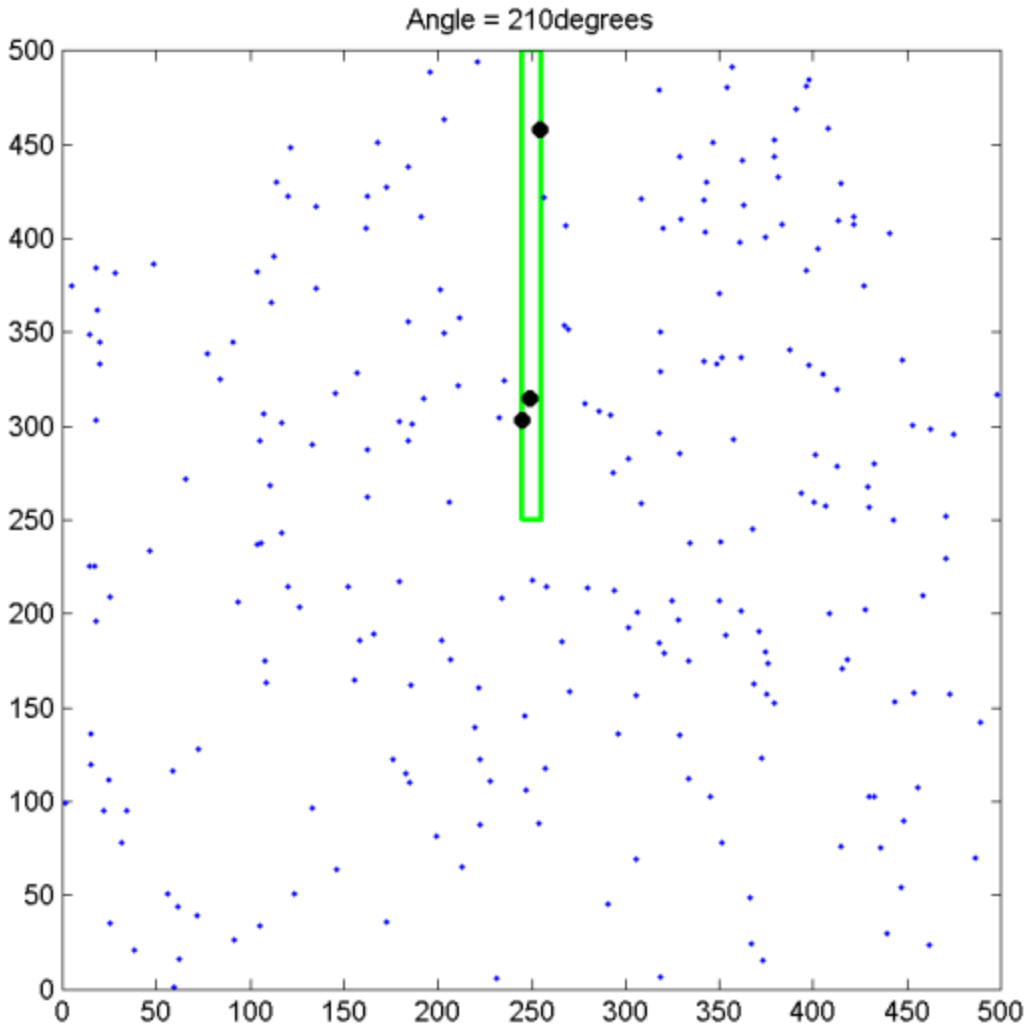

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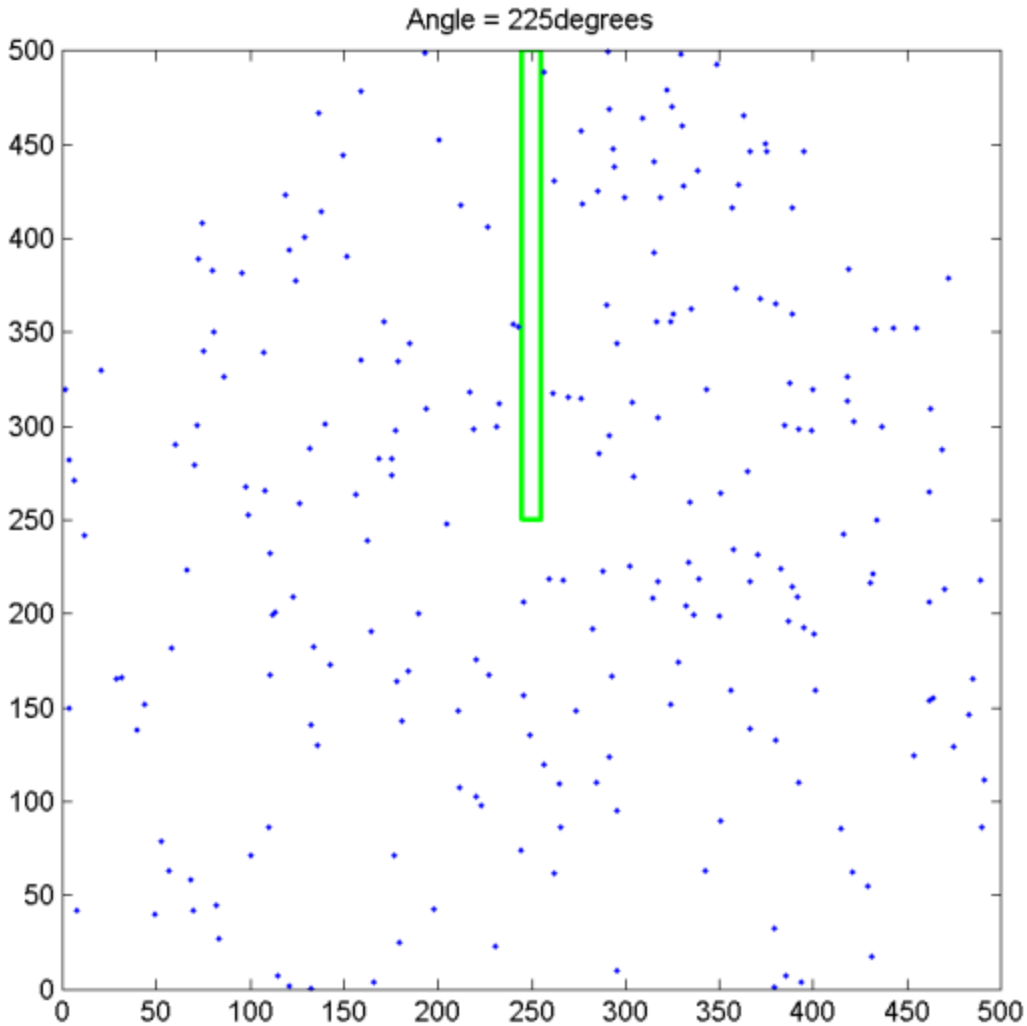

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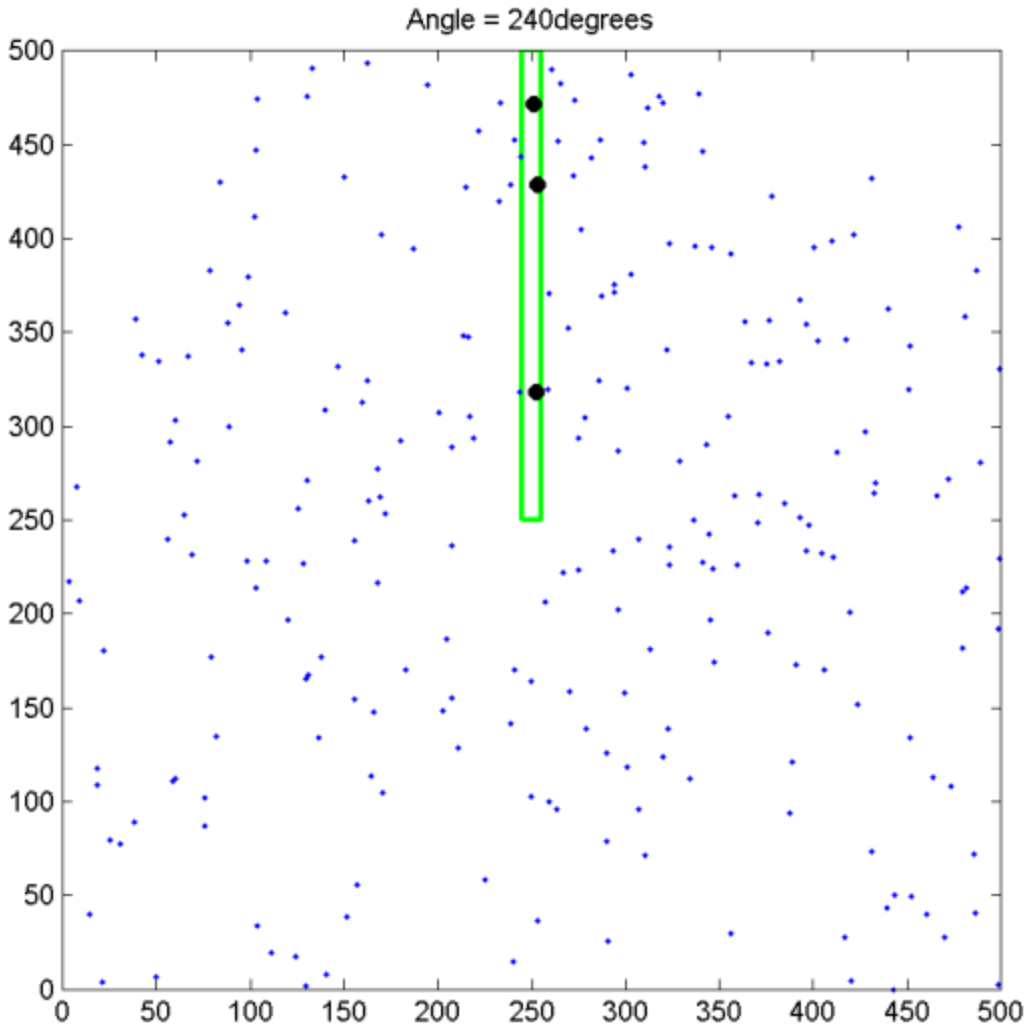

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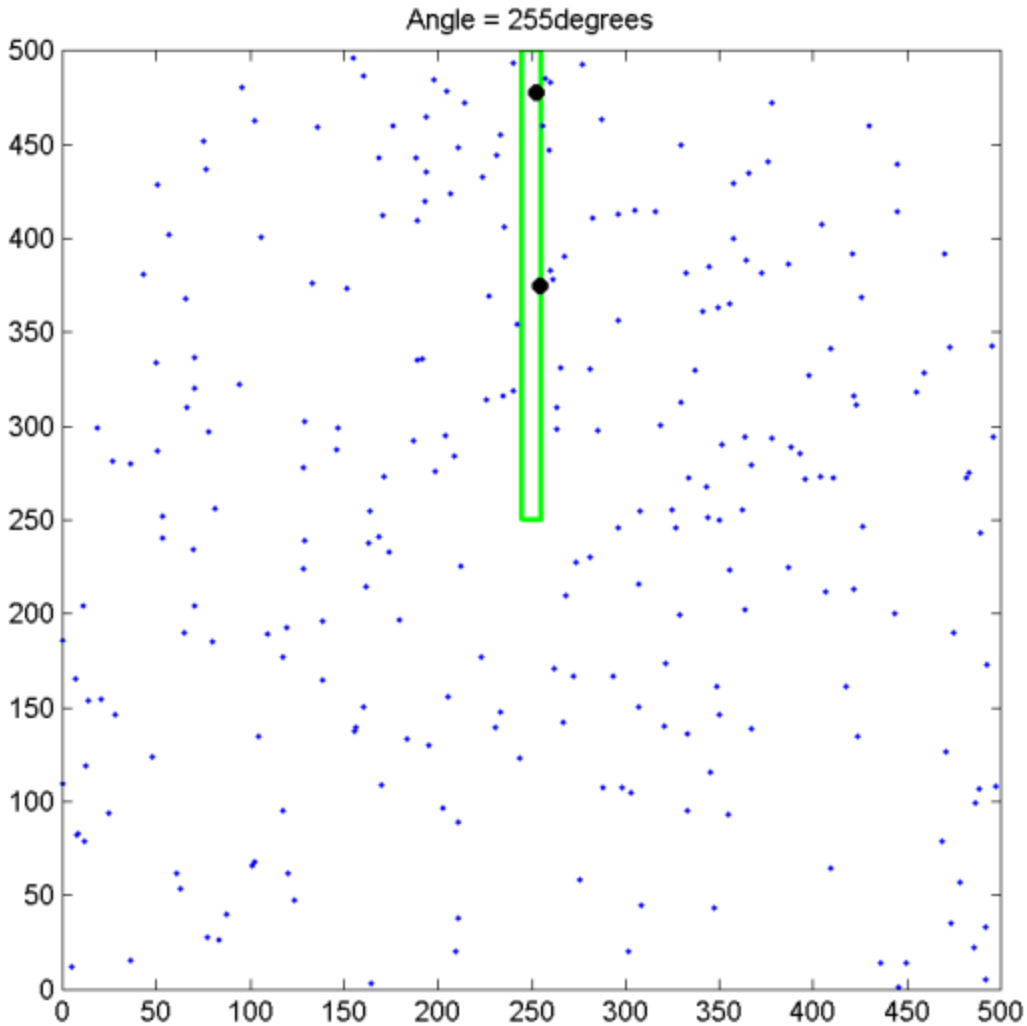

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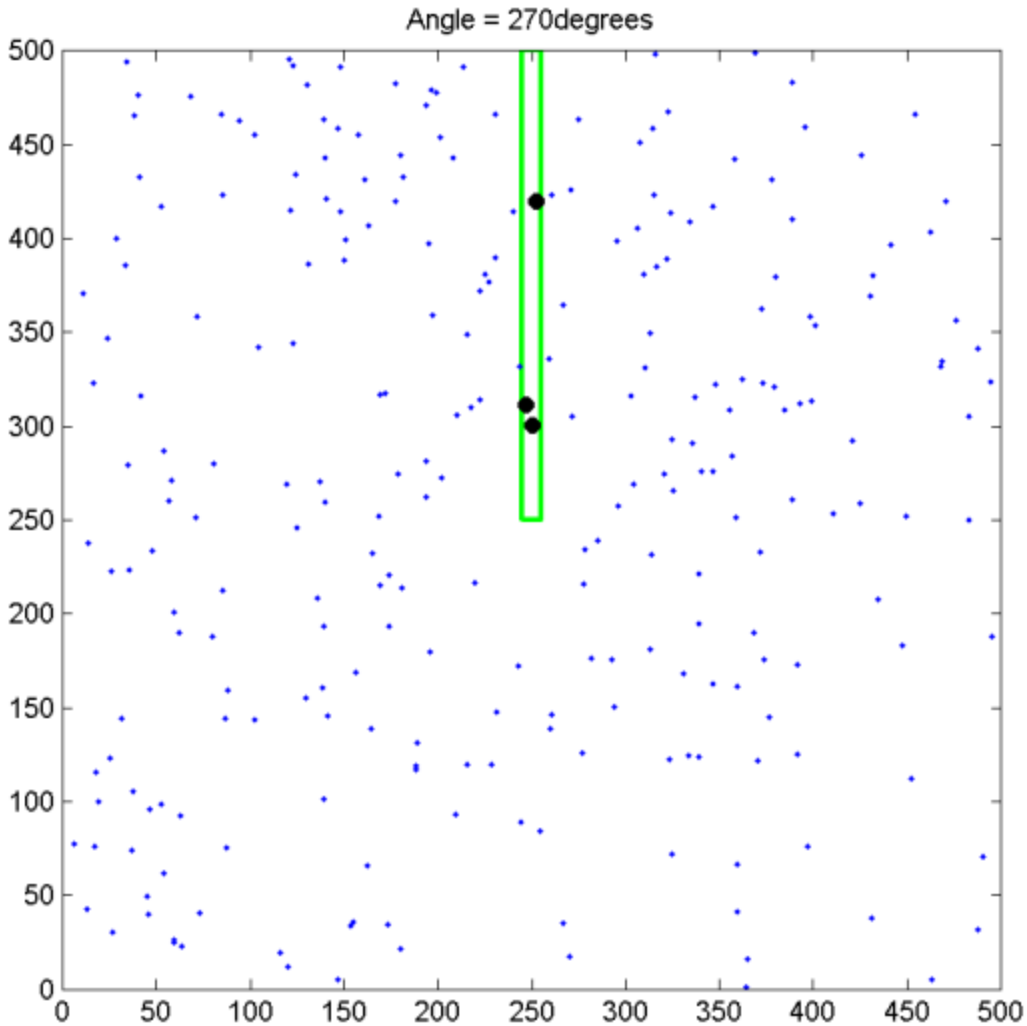

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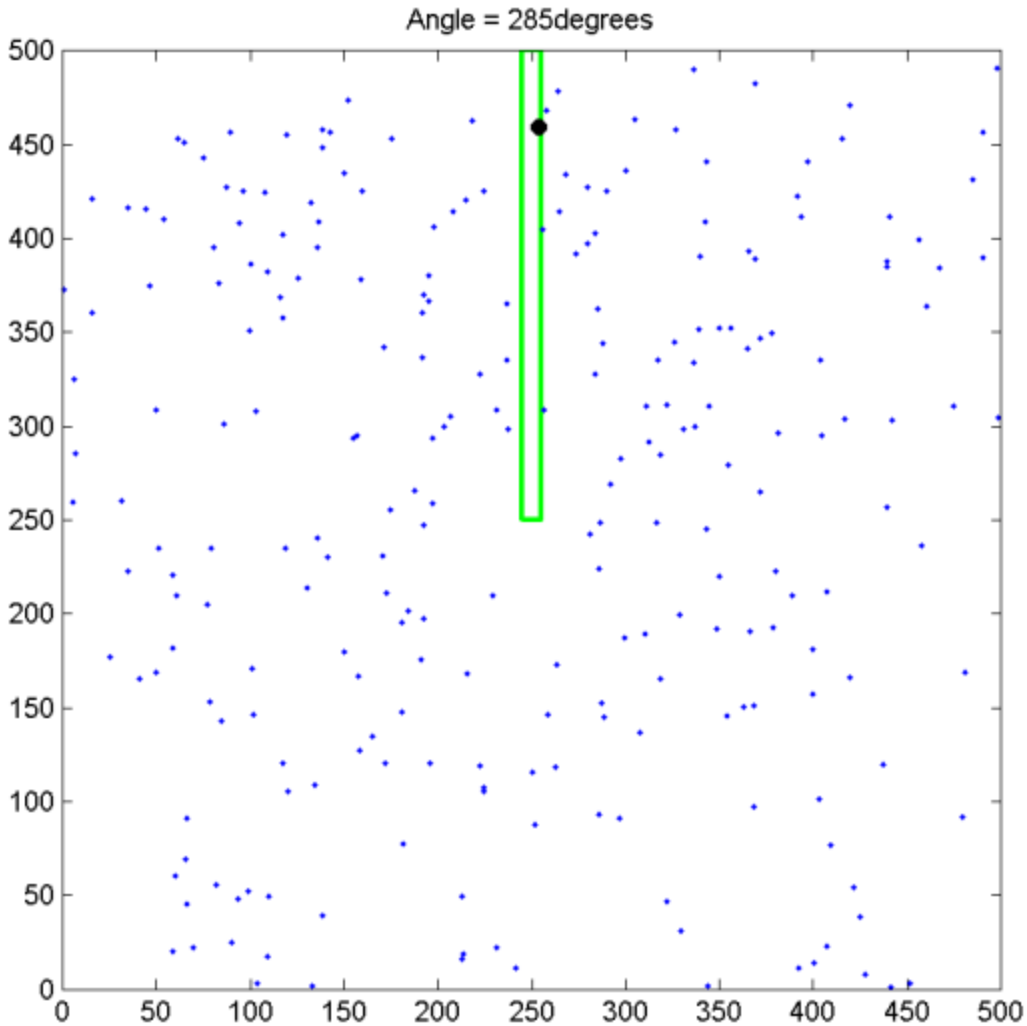

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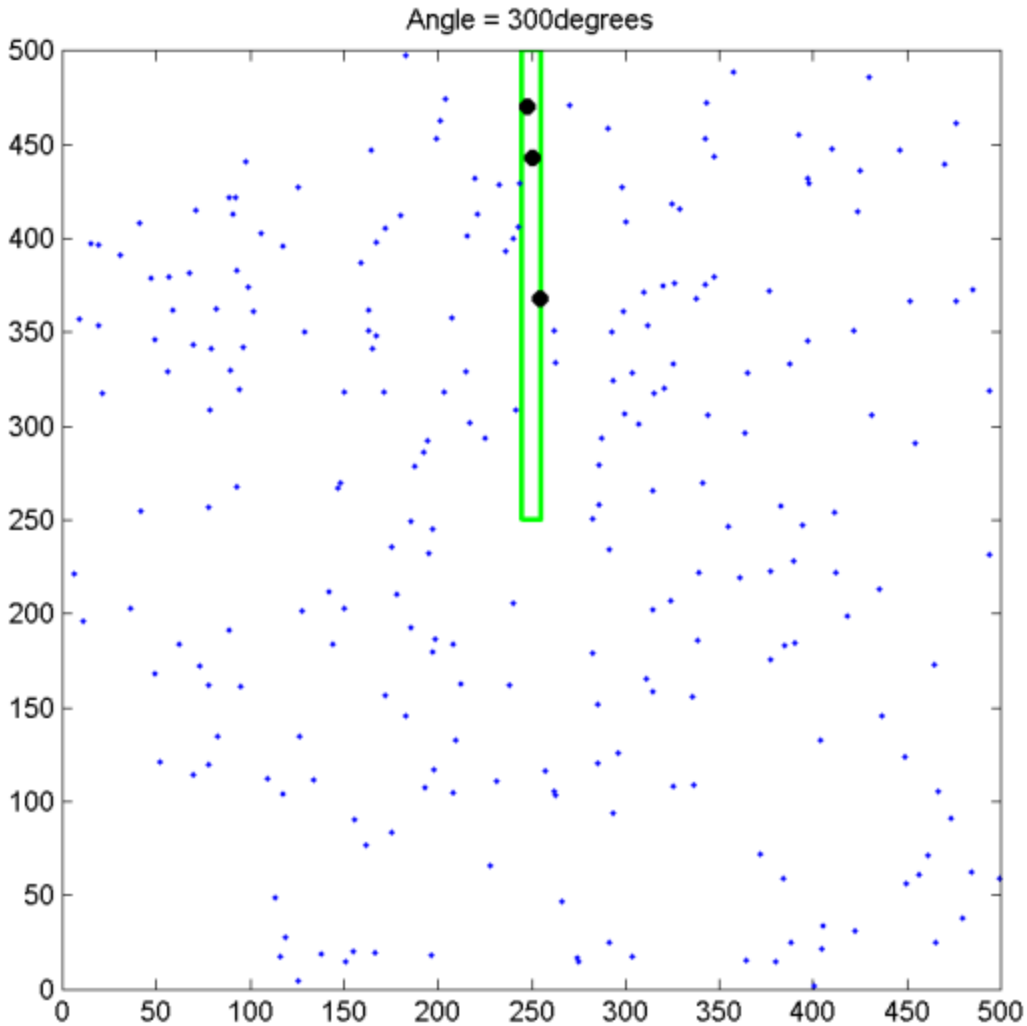

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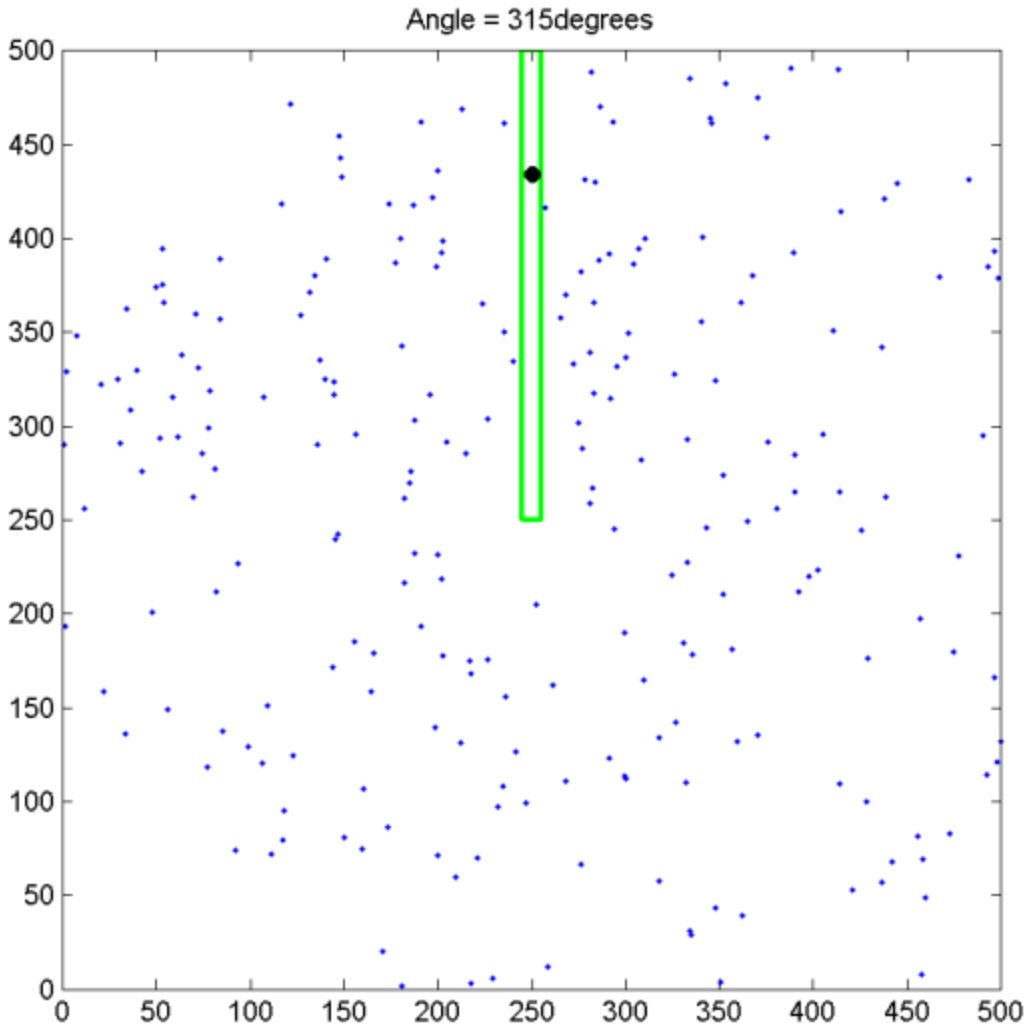

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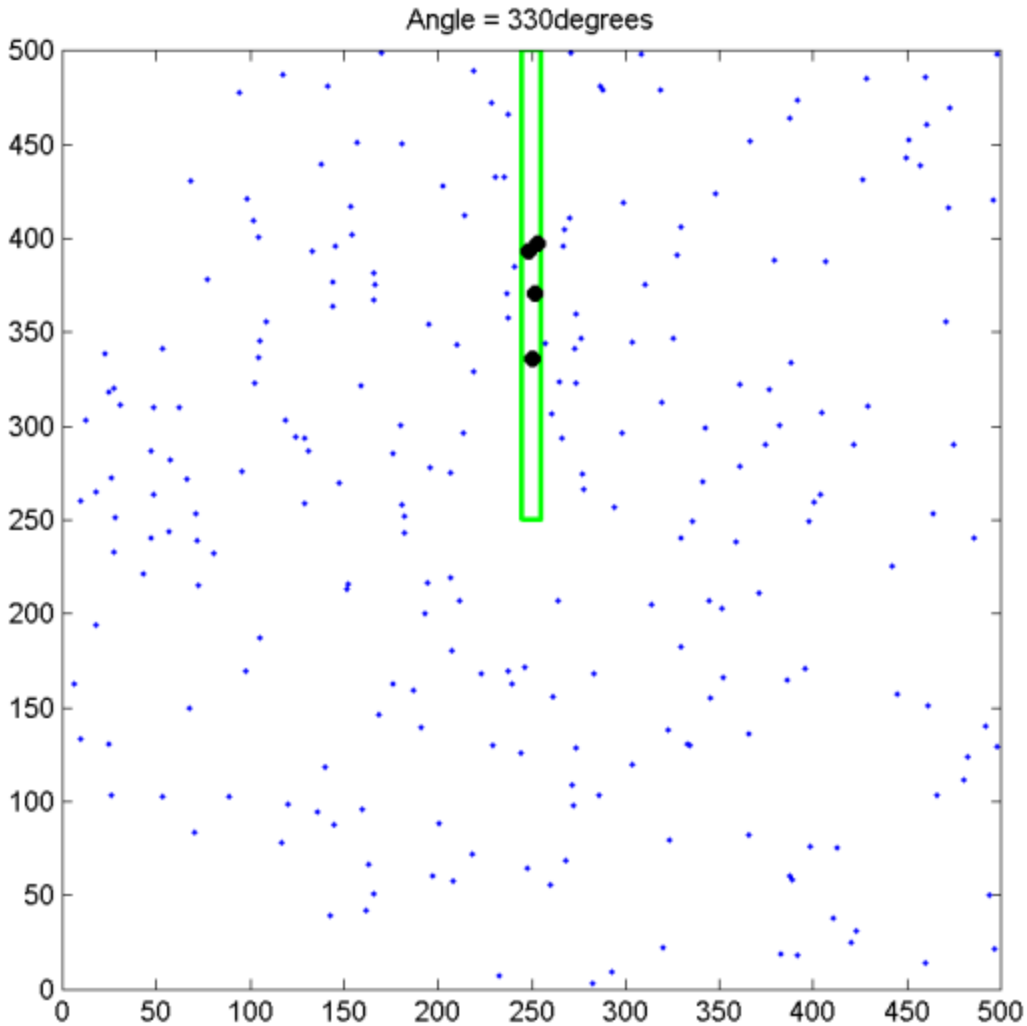
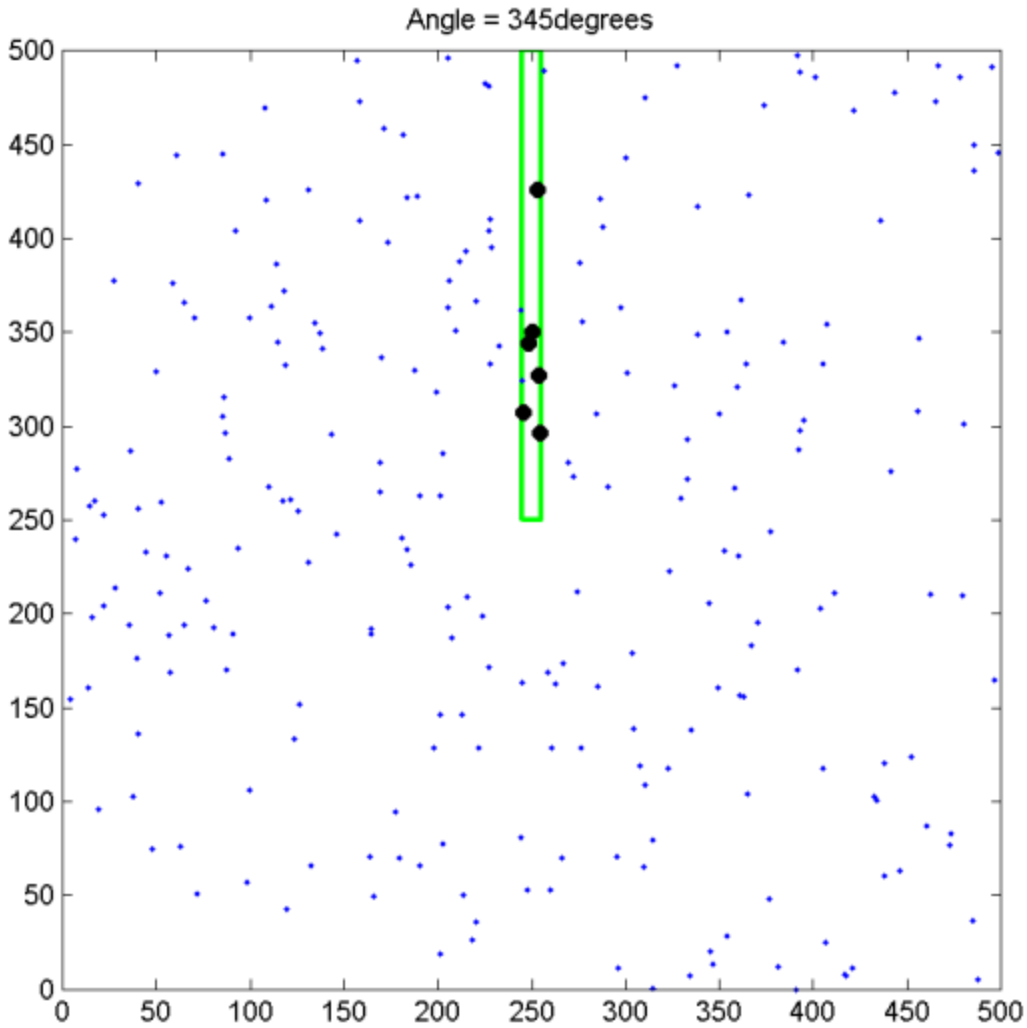
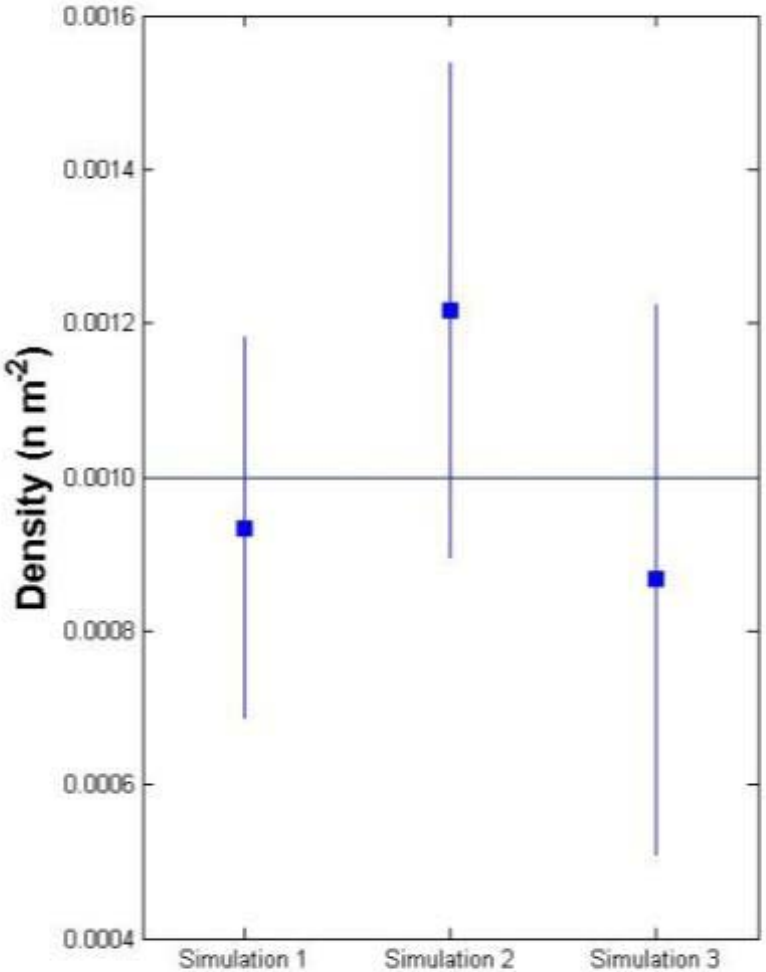


Simulation Example: Density = 0.001 m^{-2}



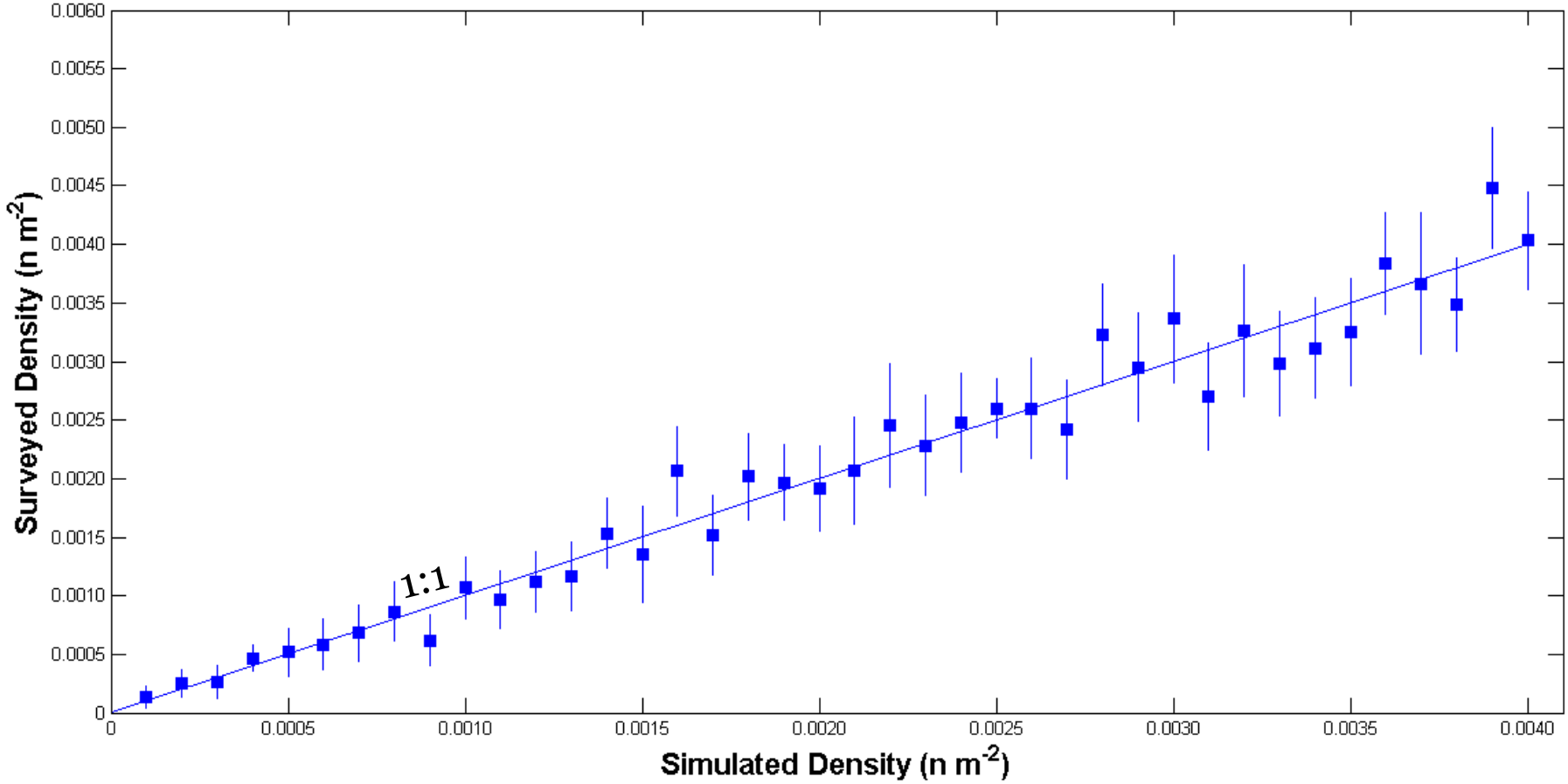
Simulation Example: True Density = 0.001 m^{-2}

Angle	Sim 1 Density	Sim 2 Density	Sim 3 Density
0	0.0016	0.0008	0.0004
15	0.0012	0.0008	0.0004
30	0.0016	0.0008	0.0020
45	0.0012	0.0008	0.0008
60	0.0012	0.0016	0.0004
75	0	0.0012	0
90	0.0004	0.0008	0.0008
105	0.0008	0.0032	0
120	0	0.0008	0.0020
135	0.0008	0.0004	0.0008
150	0.0008	0.0016	0
165	0.0008	0.0012	0.0004
180	0.0012	0.0004	0.0004
195	0.0004	0.0004	0
210	0.0012	0.0028	0.0016
225	0	0.0004	0.0004
240	0.0012	0.0012	0.0008
255	0.0008	0.0016	0.0004
270	0.0012	0.0020	0.0012
285	0.0004	0.0016	0.0004
300	0.0012	0.0008	0.0016
315	0.0004	0.0008	0.0032
330	0.0016	0.0008	0.0004
345	0.0024	0.0024	0.0024
Mean	0.00093	0.00122	0.00087

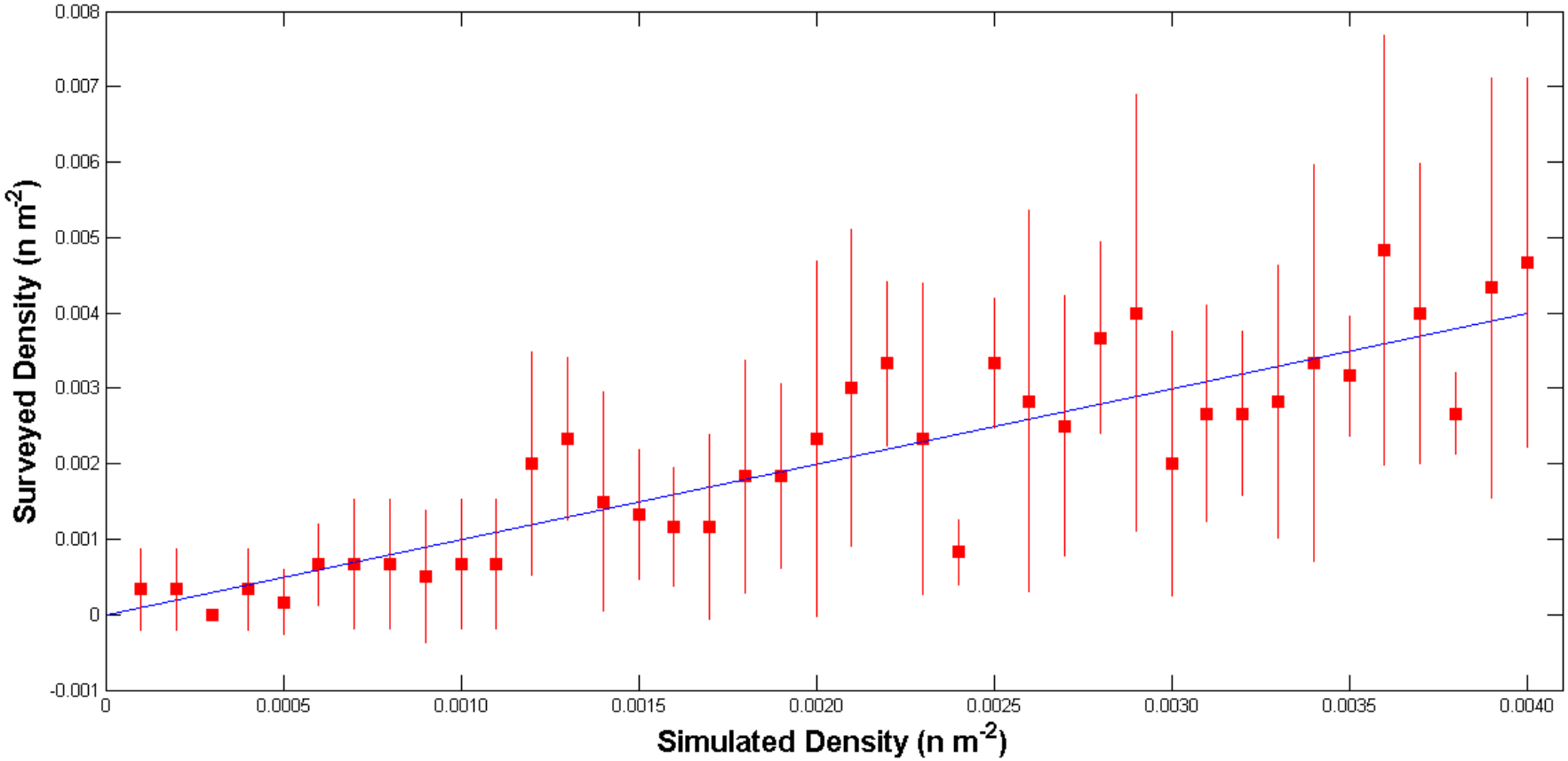


Survey Design Accurately Estimates Densities

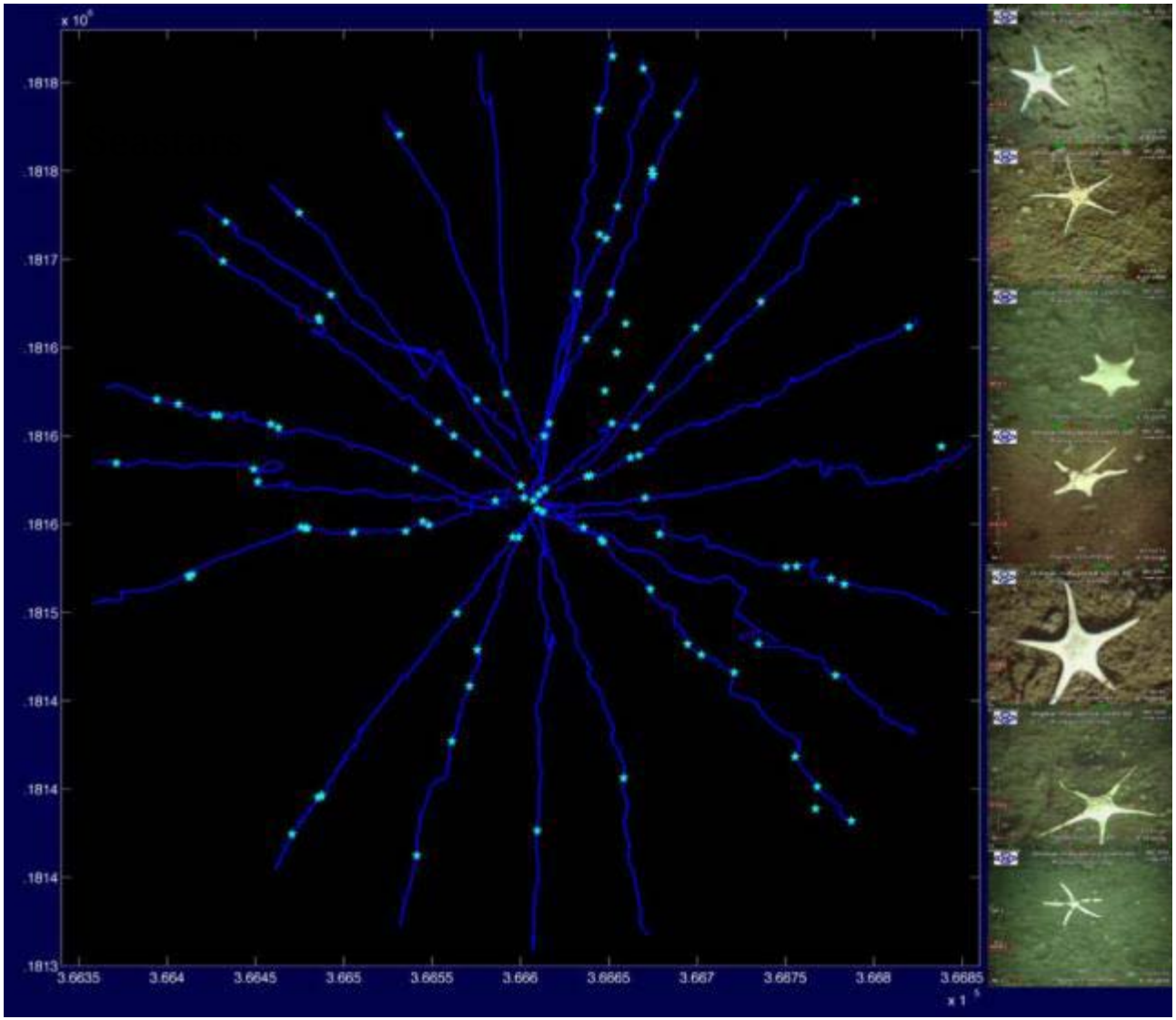
Error bars = 95% confidence intervals on the mean



BOEMRE Pre-Bottom Survey Design

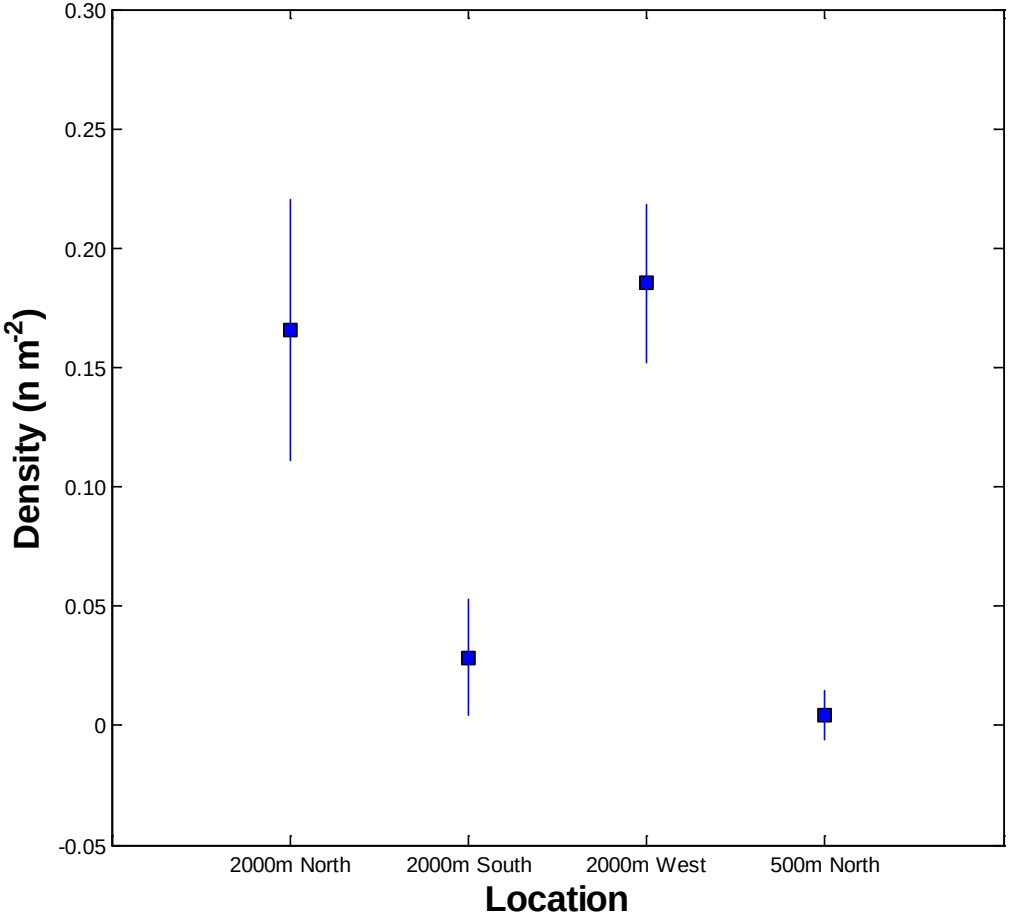


PRELIMINARY RESULTS: North 2,000 m



PRELIMINARY RESULTS BASED ON INCOMPLETE ANALYSIS OF DATA

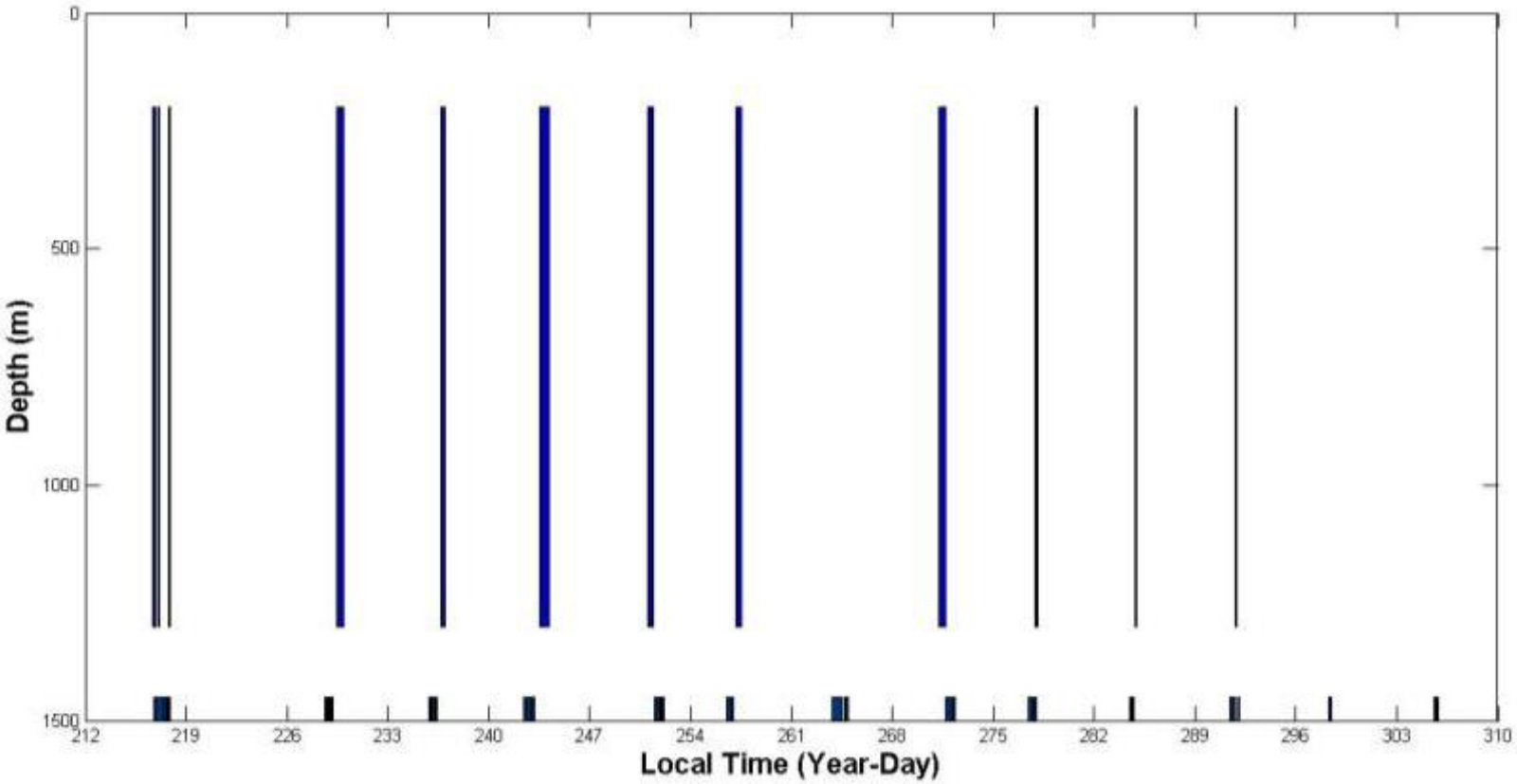
Example Results



PRELIMINARY RESULTS BASED ON INCOMPLETE ANALYSIS OF DATA

Development Driller II

- Water column and sea floor surveys conducted around Relief Well #2
- Two ROVs surveyed from 8/6/10 – 11/3/10

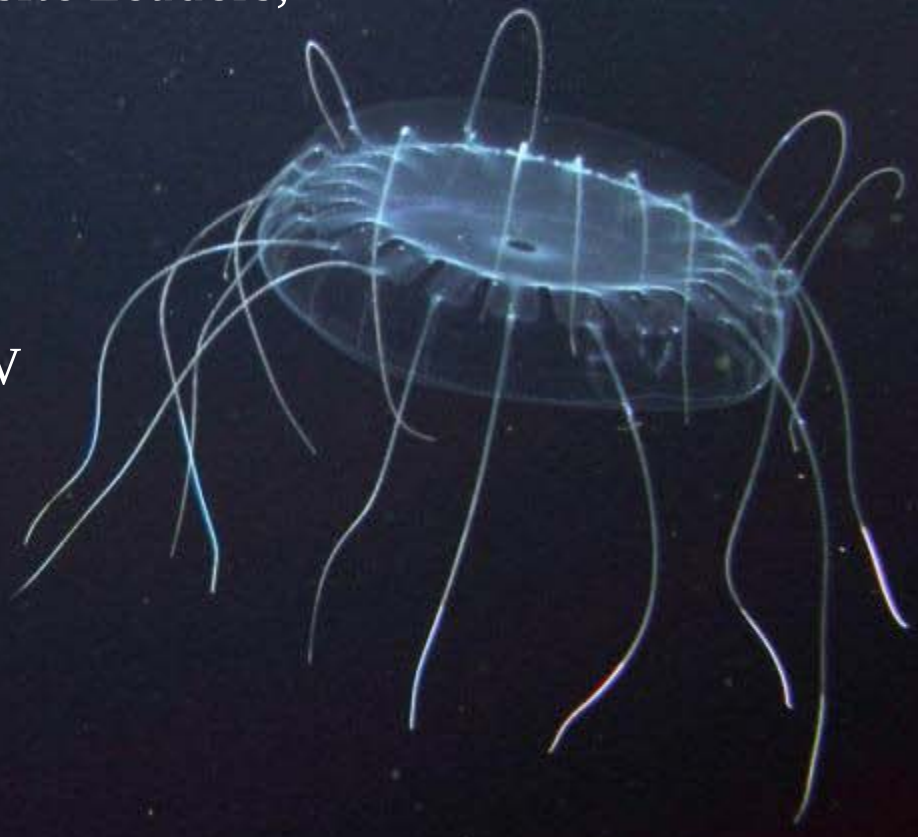


DD3 Surveys

- March 2011 at MC252
- Survey Sites: Relief Well #2, 2,000 m N, 2,000 m W (MC208 Photomosaic Site)
- HDTV + 8 megapixel digital stills camera, laser scalers, and seafloor navigation system
- Beginning of a time-series at these stations

Summary

- Gulf SERPENT has initiated a time series at stations around the MC252 BOP
- All stations surveyed during August 2010
- Follow-on surveys by the DD3 at 2,000 m W, 2,000 m N, and relief well #2.
- C&C AUV surveys will target 2,000 m W and photomosaic site in MC208
- Proposal being developed for NRDA to continue this time-series

Acknowledgments

- BP: Dr. Russell Putt, Dr. Arden Ahnell, and Melissa Simpson
- DD II ROV Teams, Wellsite Leaders, and Subsea Team
- DD III ROV Teams, Wellsite Leaders and Subsea Team
- Olympic Challenger ROV Team and Fugro Navigation Group