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# Modeling SIGINT

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# SIGINT: Detection Probability Reporting Toolset for ASW Airborne Platforms

## NRP Funded FY21: Modeling the Operational Value of SIGINT in Anti-Submarine Warfare

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## Background

- The project's goal is to more accurately model and evaluate the tactical capabilities of airborne sensors for detecting and locating ASW signals of interest.
- We developed a modeling toolset that outputs an airborne collector platform's received signal-to-noise ratio (SNR) and corresponding probability of detection via lookup tables (LUTs). Fig. 1 shows an example collection platform: P-8A.
- Our research increases the fidelity of predictive modeling for a wide variety of mission conditions that may be operationally encountered.


Fig.1: Boeing P-8A Poseidon Collection Platform

## Example received SNR plots

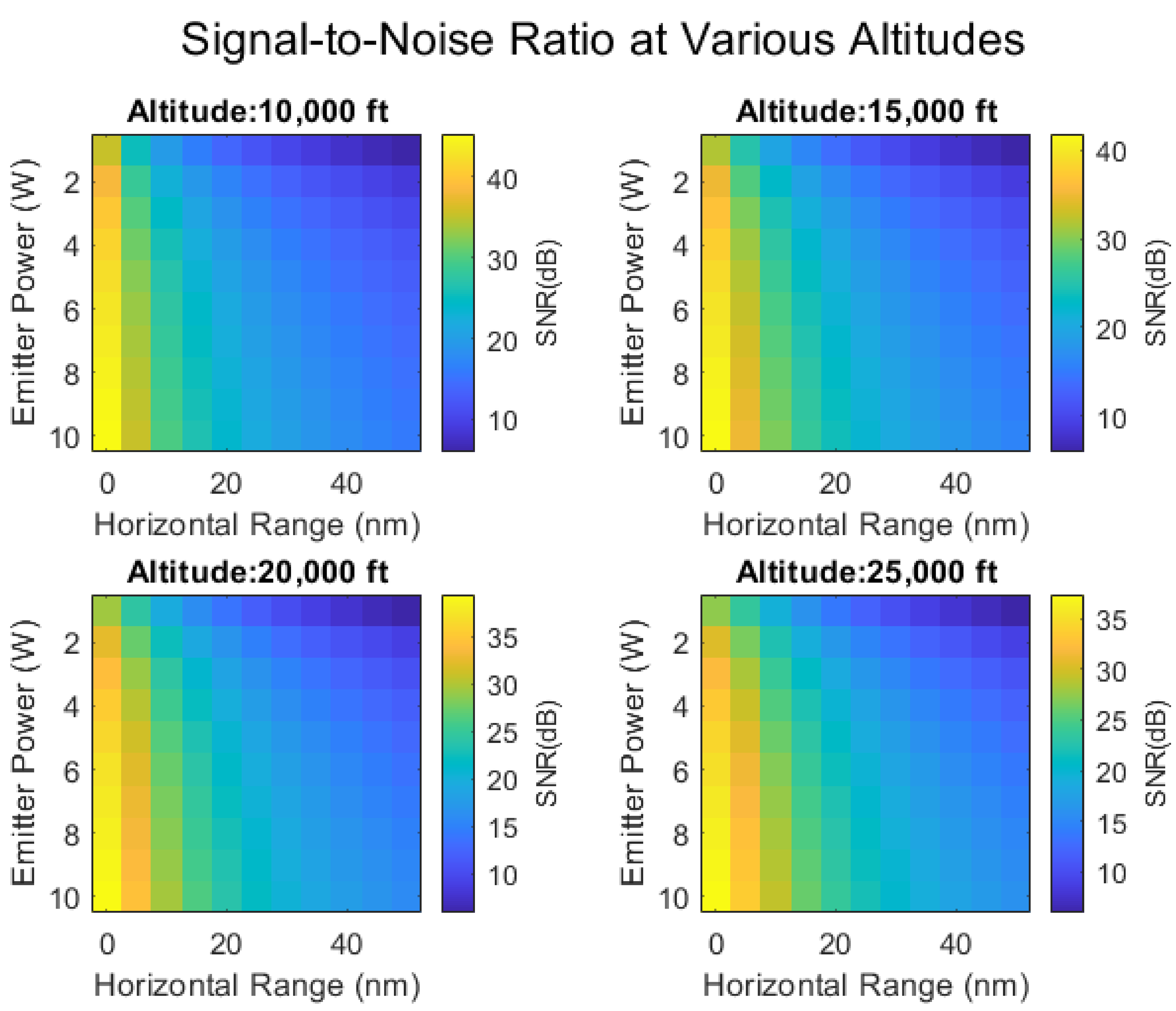


Fig. 2: Graphical received SNR plots as function emitter power and range for various standard aircraft altitudes.

- We developed a software toolset that calculates the received SNR from an emitter for various theoretical operational conditions and environments.
- These SNR calculations are useful in Monte Carlo simulations. Outputs include graphical depictions of sensor capabilities, such as those seen in Figure 2. A possible emitter is shown in Figure 3.

Fig.3: Submarine: an emitter of interest

## Probability and SNR Look up tables

- We developed various software capabilities. For example, the toolset can generate detection probability and SNR LUTs for use in SIGINT sensor capability predictions (example LUT detection table in Fig 4).
- LUTs and graphical outputs (see Fig. 2) provide detection probability and SNR changes based on threat characteristics, ASW sensor suite characteristics, environmental conditions, and other parameters of interest.
- Various factors can be parameterized. Thus, the software toolset can accommodate a variety of missions.
- These LUTs can augment mission and operational level modeling toolsets and simulations. Our toolset may be utilized to model both current and future threat signals.

Pd Table for 10,000 ft Altitude

| | 0nm | 5nm | 10nm | 15nm | 20nm | 25nm | 30nm | 35nm | 40nm | 45nm | 50nm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pt:1 | 1 | 1 | 1 | 0.99975 | 0.96783 | 0.80698 | 0.58301 | 0.3972 | 0.26973 | 0.18716 | 0.13386 |
| pt:2 | 1 | 1 | 1 | 1 | 0.99995 | 0.99389 | 0.94254 | 0.81897 | 0.6599 | 0.50942 | 0.38691 |
| pt:3 | 1 | 1 | 1 | 1 | 1 | 0.99992 | 0.99567 | 0.96491 | 0.8848 | 0.76529 | 0.63402 |
| pt:4 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99978 | 0.9949 | 0.96877 | 0.90548 | 0.80883 |
| pt:5 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.9994 | 0.99281 | 0.96661 | 0.91011 |
| pt:6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99994 | 0.99854 | 0.98936 | 0.96117 |
| pt:7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99973 | 0.99688 | 0.98436 |
| pt:8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99995 | 0.99915 | 0.99406 |
| pt:9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99978 | 0.99785 |
| pt:10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99995 | 0.99926 |

Pd Table for 20,000 ft Altitude

| | 0nm | 5nm | 10nm | 15nm | 20nm | 25nm | 30nm | 35nm | 40nm | 45nm | 50nm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pt:1 | 1 | 1 | 1 | 0.99961 | 0.96393 | 0.7996 | 0.57695 | 0.39342 | 0.26756 | 0.18592 | 0.13313 |
| pt:2 | 1 | 1 | 1 | 1 | 0.99993 | 0.99321 | 0.93997 | 0.8153 | 0.65649 | 0.50681 | 0.38508 |
| pt:3 | 1 | 1 | 1 | 1 | 1 | 0.9999 | 0.99532 | 0.96358 | 0.88258 | 0.76283 | 0.63182 |
| pt:4 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99975 | 0.9946 | 0.96783 | 0.90391 | 0.80698 |
| pt:5 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99935 | 0.99251 | 0.96584 | 0.90888 |
| pt:6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99993 | 0.99846 | 0.98904 | 0.96047 |
| pt:7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99971 | 0.99677 | 0.984 |
| pt:8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99995 | 0.99911 | 0.99389 |
| pt:9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99977 | 0.99778 |
| pt:10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99994 | 0.99923 |

Pd Table for 30,000 ft Altitude

| | 0nm | 5nm | 10nm | 15nm | 20nm | 25nm | 30nm | 35nm | 40nm | 45nm | 50nm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pt:1 | 1 | 1 | 1 | 0.99925 | 0.9569 | 0.78726 | 0.56701 | 0.38725 | 0.264 | 0.18388 | 0.13194 |
| pt:2 | 1 | 1 | 1 | 1 | 0.99989 | 0.99196 | 0.93558 | 0.80917 | 0.65083 | 0.5025 | 0.38206 |
| pt:3 | 1 | 1 | 1 | 1 | 1 | 0.99987 | 0.99468 | 0.9613 | 0.87884 | 0.75872 | 0.62817 |
| pt:4 | 1 | 1 | 1 | 1 | 1 | 1 | 0.9997 | 0.99409 | 0.96623 | 0.90128 | 0.80391 |
| pt:5 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99926 | 0.99199 | 0.96452 | 0.90682 |
| pt:6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99992 | 0.99832 | 0.98849 | 0.95929 |
| pt:7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99968 | 0.99656 | 0.9834 |
| pt:8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99994 | 0.99904 | 0.99361 |
| pt:9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99999 | 0.99975 | 0.99766 |
| pt:10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.99994 | 0.99918 |

Fig.4: Detection probability tables as function emitter power from and range for various standard aircraft altitudes.

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