

**Performance Prediction - Uncertainty DRI Workshop**  
**June 27-28, 2001**  
**Seattle, WA**

Discussion Leader- Phil Abbot (OASIS)

This session was introduced by LTCDR Van Gurley (Naval Oceanographer) who offered an operational perspective on performance prediction and the need to “help the fleet do their job better”.

The following questions were proposed to the audience:

1. What are we predicting the performance of?
  - Generic vs. specific systems
  - Security Issues of one vs. the other
2. Are we working toward improved performance prediction (TDA) and/or improved sonar system performance?
3. How do we predict the performance of a system with respect to uncertainty (i.e. applying uncertainty to Performance Prediction)?
  - Metrics and vocabulary to define performance (FOM)
    - Detection
    - Classification
    - Localization
  - Relevance of the sonar equation
4. Where does the uncertainty DRI effort stop (in the end-to-end problem) and how does it transition to the fleet?
  - What are the “Nuggets” for the fleet?
5. End-to-end data sets and transition to the Fleet Naval Capabilities (FNC)
  - Through a system?
  - With targets present?
  - Processing system?
6. How to collaborate with NUWC fleet team.

**Notes on the Discussions**

What is the objective of the Uncertainty DRI: to predict the performance of a specific or a general system? The answer raises issues of security.

The guidance issued from Terry P. was that all work should remain unclassified and that “generic” system would be used for performance prediction work.

Most workshop members (but not all) have security clearances and can hold informal discussions, however, we do not want to raise the security level of the DRI. The results and products for the Uncertainty DRI can be handed off to the FNC (Future Naval Capabilities) for evaluations with specific systems

Transition to the FNC process -- ONR's Dave Johnson will have a program that will use potential products from this DRI.

Questions regarding the relevance of the sonar equation. Since this DRI will be primarily a 6.1, 6.2, a little 6.3 program, the group may need to consider defining other metrics. The group (and the Navy) needs to go beyond the "range of the day" and think about new performance metrics. Especially if the objective is to optimize other parameters such as classification, localization or for future systems that will employ adaptive signal processing

Sonar equation can be used as a guide. Each term in the sonar equation allows us to focus on that term individually and is a good way to outline the work.

Sonar performance prediction vs. improving performance prediction. How could improved performance prediction not lead to improved performance.

Need more confidence in predictions; do we want to incorporate adaptive sampling to reduce uncertainty?

The fleet needs to know what cannot be done or what the risks are by using the outputs. In the past, the fleet pushed to get an answer...usually a single valued answer. Example, in a particular area, the results may have high confidence vs an area where we might have bad data and low confidence. If we do not differentiate, the user will loose confidence in the prediction.

Improve understanding of uncertainty

1. Equipment line-up
  2. System placement
  3. Tactical decisions in specific scenarios (operational)
- Drives how to formalize uncertainty of the battlespace

Requires operational research evaluation

Recommendation for MOE (Measures of Effectiveness)

FOM (Figure-of-Merit) equation refers to signal excess. The blip on the screen not a target. Need classification to determine whether blip is a target. Not a linear transform. No single attribute can classify...need multiple attributes.

Terry P.: Reducing uncertainty in classification not a part of this DRI.

One response: Invalid, no-good if does not address classification.

Consider an expert system that tries to get an answer to multiple questions, it goes beyond a single value answer.

Suggestion: The value of reducing uncertainty in performance prediction needs to lead to better classification. Example, when will blip on screen called as possub.

Issue: User gets range of the moment which fleet considers suspect. Performance model that gives SE vs. range is considered better (officer interpreting result must understand).

Detection and levels of classification:

Lowest classification is that something interesting is on the screen, need to identify blip to be meaningful

Communicate uncertainty, worst case scenario is that it is a target

Develop the formalism to quantify uncertainty in performance prediction and transfer what actually happens to the FNC.

Metrics should include the quantity of the variances not the mean. The uncertainty should be incorporated in the performance metric.

Potential “nuggets” to the fleet:

“rules of thumb” (comes out of observation)

“sea bottom people” have an opportunity to create an individual nugget

If “range of the day” is 10km +/- 5 km. What does 5km represent?

Perhaps we should strive to say that this is a target with 65% probability. Can reduce to simplest probability that is easiest to understand. Need the ability to assign a probability to each detection due to uncertainty in the environment.

In-situ environmental assessment nugget? What are the drivers/parameters that can be improved by sampling or re-deploying resources to reduce uncertainty?

Concern rose about the need for the attribution of uncertainty and sensitivity to uncertainty as a critical element.

Use battlegroup assets to build tools to collect “on the fly”, adaptive sampling. Answer: What is the most important thing to do? And where do I need to do my job better?

Understanding of PDF in terms of probability of detection.

Are we routinely overpredicting?

Assume normal distribution but may not be in reality. May be skewed due to non-linearity's and may cause overpredicting

Availability of MODAS on siprnet?