COMPARISON OF CONGRATS RAY TRACING PREDICTIONS WITH MEDUSA MEASUREMENTS OF REVERBERATION

(ABSTRACT)

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INTRODUCTION

From the user's point of view, ray tracing is just a computer procedure which is inserted into larger programs of different degrees of complexity. The following table indicates in which kind of programs this procedure is used at SACLANTCEN. It ranges from mere qualitative descriptions of the sound field to detection models.

TABLE 1

USE OF RAY TRACING PROCEDURES

1. Qualitative description of sound field
   RAY PLOT
2. Single ray descriptions
   SPREADING LOSS, TRAVEL TIME, ANGLE
3. Combined loss (coherent and incoherent), multipath
   EIGENRAYS
4. Reverberation, echo level
5. Detection model

The experimental verification of ray tracing procedures should be most significant on the level No.3 of the above table.

However — as mentioned already in Mr Vettori's presentation (see Session 3 of these Proceedings) — one can only measure a few points of the loss curve in a whole day.

In reverberation experiments (level No.4) we obtain with each ping a continuous curve covering the full interesting range [see Fig. 1]. But we have now a higher degree of uncertainty, because of the unknown behaviour of the scattering layers at long distance. But with some precautions one may well draw conclusions on the validity of the ray tracing program.

From five examples which are extensively discussed in a Technical Report* result the following tentative conclusions:

1. The curvilinear ray tracing procedure and the reverberation procedure of the CONGRATS programs (see presentation of Messrs Weinberg and Cohen in Session 2 of these Proceedings) predict reverberation levels which agree within 3 dB with measurements, as long as there are no caustics.

2. In the reverberation procedure the local scattering strength is combined with the calculated propagation loss. As both the reverberation level and the separately measured propagation loss (see presentation of Mr Vettori) agree outside of caustics with prediction, it follows that the reverberation procedure itself is correct.

3. The calculated reverberation level is always too high in caustic regions. But, as the reverberation procedure is correct it must be the propagation loss procedure (derived from ray theory) which is not valid any more in caustic regions.

4. Finally this comparison shows that it is possible to predict sound fields up to a range of 35 km on the basis of a single measurement of the sound velocity profile, volume scattering profile and wind.

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* B. de Raigniac, W. Bachmann, and J.S. Cohen, "Comparison of Reverberation Measurements Using the MEDUSA System with Computer Modelled Data"(NU), SACLANTCEN Technical Report in preparation, NATO CONFIDENTIAL.

DISCUSSION

The discussion of the previous two papers centred on the sound speed profile used as input to the computer model. That the temperature profile was not measured for each run was not thought to be important, as evidenced by the fact that ray predictions from an average profile did not differ significantly from predictions based on an extreme profile.

It was pointed out that salinity variations could have a marked effect. (For example, when a sound channel exists, its estimated width could be in error by as much as 150 m if the salinity variations are ignored.) However, the authors were of the opinion that in their case the use of a uniform average salinity was adequate, and were supported in this view by direct sound speed measurements.

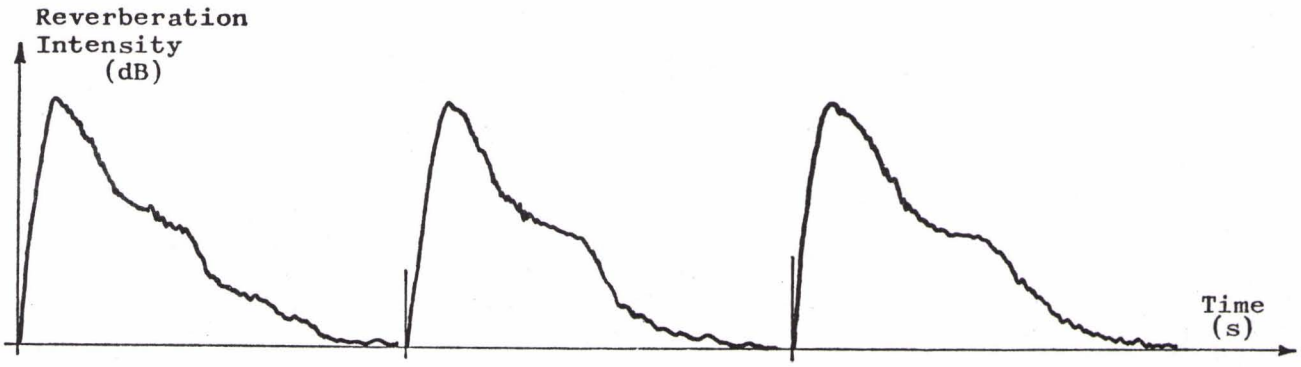

FIG. 1