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COMPUTED MOTION RESPONSE OPERATORS FOR THE USCG WHEC HAMILTON,(U)
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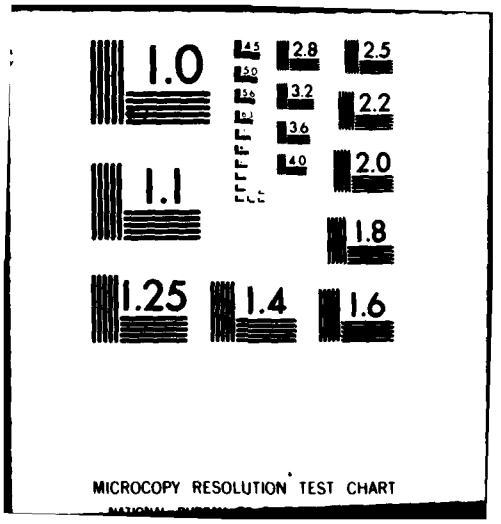
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DEPARTMENT OF THE NAVY
United States Naval Academy
Annapolis, Maryland 21402

Division of Engineering and Weapons

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Report No. EW-1-82

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D.D. Moran*
D.M. Gentile**

January 1982

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INTRODUCTION

The response amplitude operators for the USCG WHEC Hamilton were computed as a part of a thorough research program being conducted by the U.S. Naval Academy. The subject of this program is the study of the deviations between responses of displacement ships to large amplitude discrete, grouped or episodic waves and responses predicted through classical theory in regular periodic small amplitude waves. The predicted responses contained in this report were computed using the U.S. Navy standard ship motion prediction tool, SMP.

Predictions from linear superposition theory form a base for the development of the large amplitude wave experimental program. These results provide an indication of the critical operational conditions in terms of response modes (pitch/heave), critical encounter frequencies (and their corresponding wave lengths), headings, and ship speeds.

The enclosed linear theory is a valid parametric base which allows examination of the effect of ship moment of inertia in pitch (or pitch radius of gyration) on the response characteristics. Enclosed are the responses for the Hamilton for seven values of pitch radius of gyration ranging from .19 to .31 in increments of .02. This vital parameter has been ignored in recent ship motion and hull optimization studies but has been found to be an essential parameter for ship motion characterization.

The overall goal of the study is to examine the extent of deviation from linear response theory as the ship encounters large amplitude, discrete, grouped or episodic waves. As the wave amplitude is increased experimentally, the small amplitude responses will be systematically and thoroughly checked against and compared with the linear analytic predictions.

The linear superposition theory forms the backbone of irregular sea response predictions using classical theory. In fact, if classical linear superposition is used to predict sea state response, linear response data is perfectly suitable. The employment of nonlinear response operations in sea state prediction will require a new, modified, (presently nonexistent) superposition theory.

The enclosed calculations represent a permanent data base, since they need never be repeated. Thus, they are presented as a permanent reference for the USCG WHEC Hamilton for future studies of this type.

COMPUTER OUTPUT DESCRIPTION

Each of the seven computer outputs contains the response amplitude operators (RAO's) for the six degrees of freedom of a ship: surge, sway, heave, roll, pitch and yaw. Also included are the RAO's for the absolute motions and the relative motions at a forward perpendicular point at the waterline and on the centerline and a stern point on the centerline and 10.5 feet above the baseline. All RAO's are given for 13 ship headings, 7 ship speeds and 30 frequencies. Headings range from 0 to 180 degrees in increments of 15 degrees, ship speeds range from 0 to 30 knots in increments of 5 knots and frequencies range from .2 to 2. radians/second for a total of 30 frequency values.

Predicted motions in one foot signficant long- and shortcrested seaways are given in terms of significant single amplitude statistics. The seaway is modeled by a Bretschneider spectrum and computed for modal periods of 7 to 21 seconds in increments of 2 seconds. Encountered modal periods are also given.

A computer generated representation of the WHEC underwater hull is presented in Fiugre 1. This is the hull definition, given in terms of stations and offsets, used by SMP to compute the ship hydrostatics and ship responses. For a detailed description of the computer output see Reference 1.

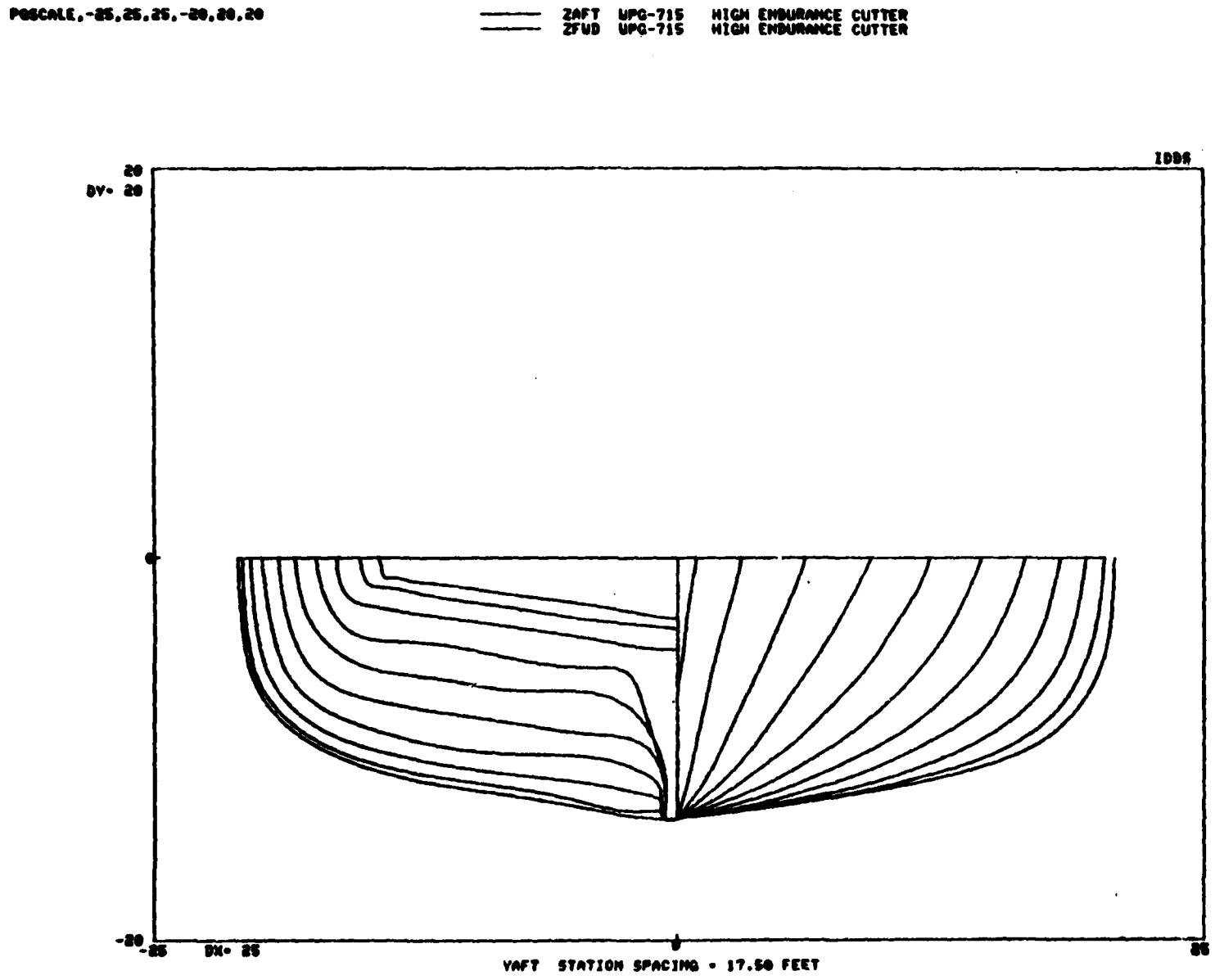

Figure 1. Computer Generated Spline-Fitted Hull Lines for the USCG WHEC Hamilton

REFERENCES

1. Meyers, W.G., T.R. Applebee, and A.E. Baitis, "User's Manual for the Standard Ship Motion Program, SMP", Report DTNSRDC/SPD-0936-01 (September 1981).

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ppendices A through G are presented in microfiche form accompanying
his report.

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