Written discussion on:
Resistance and Seakeeping Characteristics of Fast Transom Stern Hulls with Systematically Varied Form by E. Lahtiharju e.a.

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Resistance and Seakeeping Characteristics of Fast Transom Stern Hulls with Systematically Varied Form.

by: E. Lahtiharju, T. Karppinen, M. Hellevaara and T. Aitta.

The authors present in their paper very valuable information on the vertical motions of high-speed vessels.

The differences between the two versions of the strip theory are attributed to an inclusion in the original strip theory (OST) and an exclusion in the modified strip theory (MST) of the added mass "end-terms". In fact, an inclusion or an exclusion of these terms in the left hand side of the equations of motion is defined by the integration boundaries of the derivatives:

Inclusion: \[ \int_{0+\epsilon}^{L-\epsilon} f'(x) \cdot dx - (f(0) - f(L)) \]

Exclusion: \[ \int_{0-\epsilon}^{L+\epsilon} f'(x) \cdot dx + (f(0) - f(L)) \]

Whereas, when using numerical integrations from 0+\epsilon until L-\epsilon, the expressions "inclusion" and "exclusion" are confusing: in case of an exclusion of the "end-terms" in the left hand side of the equations of motion, extra "end-terms" have to be introduced at the wave loads in the right hand side of the equations.

To verify the explanation for the differences between the strip theories, the vertical motions of the bow of the NOVA-II vessel have been calculated at Fn=0.864 with the Delft University of Technology six degrees of freedom ship motions program SEAWAY for the two strip theories without and with these "end-terms". To obtain the hullform, a Lewis approximation has been used. The results are presented in figure 1, below. Comparable results have been obtained with the 10-parameter conformal mapping technique.
and Frank's pulsating source method for the NOVA-I vessel, of which a body plan is given in the paper. Figure 1 below, taken from figure 28 of the paper, does not confirm the explanation fully. But certainly, it is one of the reasons for differences. In this particular case, the experimental results are situated between the OST without "end-terms" and the MST with "end-terms", so close to strip theories with inclusions and exclusions opposite as used in the paper.

It is mentioned in the paper that different expressions for the heave exciting force and the pitch exciting moment should have a relatively small effect on the computed heave and pitch. In literature a lot of attention is paid to the left hand side of the equations of motion, but generally less attention is paid to the definition of the exciting wave loads in the right hand side of the equations, which are of equal importance. These loads consists of a Froude-Krilov part and a diffraction part. For the calculation of the diffraction part, often a pressure level in the fluid will be chosen. However, this can be done in different manners. The definition of the wave loads and the presence or absence of "end-terms" in the paper is not fully clear.

In SEAWAY, the Froude-Krilov loads are expanded in series. Then the dominating term in the relevant part of these series delivers equivalent directional components of the orbital accelerations of the water particles. From this, equivalent orbital velocities are found. These orbital motions and the hydrodynamic coefficients are used to calculate the diffraction part of the wave loads. At high forward speeds the contribution of this part into the total wave loads can become significant, which holds that its definition can be important.

I would like to have comments of the authors on this.
Figure 1. The Vertical Motions at PP of NOVA-II in Head Waves at Fn = 0.864
VERTICAL MOTION/WAVE AMPLITUDE

OST Original Strip Theory (+) with "end-terms"
MST Modified Strip Theory (-) without "end-terms"

NOVA II
Fn = 0.864

EXPERIMENTS : Lahtiharju, et.al.
CALCULATIONS: Program SEAWAY

WAVE/SHIP LENGTH
OST Original Strip Theory (+) with "end-terms"
MST Modified Strip Theory (-) without "end-terms"

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\text{NOVA II-} \quad F_n = 0.864
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EXPERIMENTS: Lahtiharju, et al.
CALCULATIONS: Program SEAWAY