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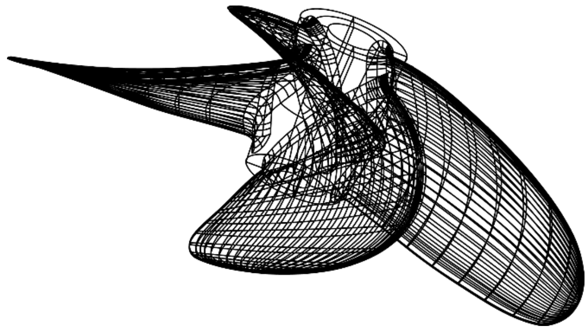
Propeller design and what I really need

Understanding how the term "propeller design" has various meanings

The term "propeller design" means different things to different communities and different technical objectives. The term captures three principal steps of increasing detail from initial concept exploration for identification of a successful propulsion system all the way through delivery of a manufactured product to a customer.

The first step in the overall propeller design process is typically the determination of principal propeller parameters for a particular vessel and proposed propulsion drive system. The propeller is a component of a *Vessel-Propeller-Drive* system, and the objective is to identify things like suitable propeller blade count, diameter, pitch, blade area, and shaft RPM. For this task, we typically use "parametric methods" (i.e., propeller series, such as B Series, Gawn, Kaplan) as they are grounded in real test data and the calculations are almost instantaneous. This makes design space "what if" investigations practical and effective for the determination of attainable top speed, cavitation levels, or required engine power. That said, one aspect of these calculations needs to be made clear. While series propellers can very accurately determine performance of a manufactured propeller – if that propeller's geometry is of the same series – they often act as a "calculation proxy" where their predicted efficiency and resulting principal parameters are suitable for hydrodynamic and propulsion system simulation. (Note that there are several ways that series calculations have been updated to include non-series characteristics such as operation in oblique flow, cambered blade forms, or the addition of cup.) Then, more detailed propeller design calculations can dial in the propeller's geometry for the performance requirements of a specific ship (as described below). Therefore, rather than calling this "propeller design", we typically see "propeller sizing" or "propeller matching" used as the term for when we optimally relate the *Propeller* to the *Vessel* and *Drive* at this system-level propeller design stage.
Typical community: naval architects
Typical objective: system-level determination of propeller characteristics and efficiencies
Tool: HydroComp NavCad

When further optimization is needed for the design of a propeller for a specific ship or to employ contemporary attributes, a "wake-adapted" design tool is utilized for "design for performance". This takes the information from the system-level investigation (above) and information about the wake (velocity) distribution that the propeller would see due to its position relative to the vessel to deliver an optimized design which would include radial distribution of pitch and camber (for principal thrust-making), thickness (for acceptable strength), and blade outline (chord length, skew, and rake for cavitation and hydroacoustics). This step is typically not needed if your objectives do not include responsibility for detailed propeller design, such as when you look to specialists or manufacturers for this design stage. However, if you benefit by investigating how a propeller optimized for a vessel might perform and what concerns may be raised – such as a naval architect involved in a design where cavitation and hydroacoustics is critical or a propeller modification is proposed – then this capability can be very valuable.
Typical community: propeller design specialists and naval architects
Typical objective: optimized detail design for performance
Tool: HydroComp PropElements



Finally, when it is time to manufacture a propeller, specialized geometric "design for manufacture" tools are needed. The manufacture of propellers has various unique requirements depending on the propeller's size and application. For example, large commercial propellers typically require submittal of blade thickness calculations to classification societies, or development of special pattern models that consider the shape deformation inherent in the casting and milling process. This stage is most frequently limited to builders of propellers and their designers that are responsible for preparation of classification reports, design drawings for manufacture, and 3D geometries for milling.
Typical community: propeller builder design staff
Typical objective: documentation and geometric data for manufacture
Tool: HydroComp PropCad

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