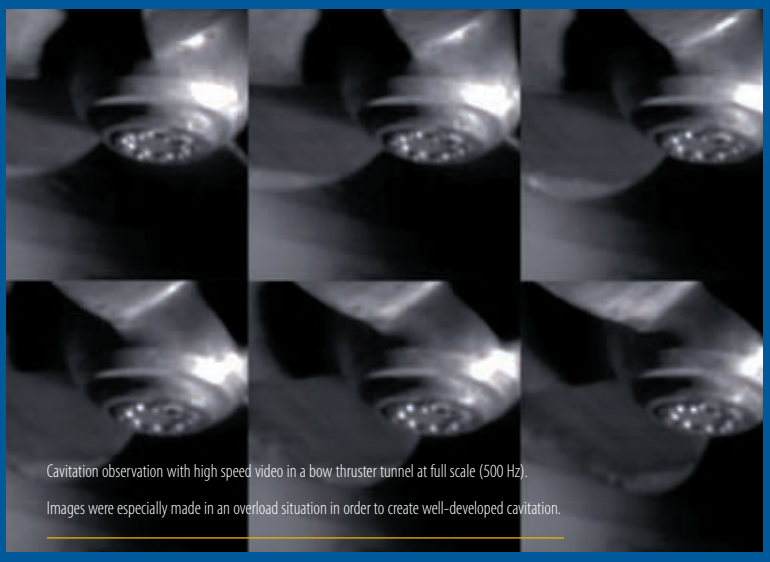
Cavitation dynamics revealed through high-speed video



Cavitation observation with high speed video in a bow thruster tunnel at full scale (500 Hz).
Images were especially made in an overload situation in order to create well-developed cavitation.

Recent developments in high-speed video cameras are allowing the industry to look at cavitation dynamics through new eyes. MARIN is at the forefront of this latest revolution.

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Traditionally, cavitation on ship propellers is observed visually using time-lapse video recordings. In a certain condition, the cavitating propeller is captured once at every revolution. This technique is based on the assumption that the cavitation is periodical and repeats itself at every revolution. By using a trigger mechanism on the shaft and powerful stroboscopic light, clear images of the cavitation can be obtained. A time-lapse recording however, is limited to an instantaneous picture of the cavitation which basically is a dynamic process.

The recent development of high-speed, high-resolution, video cameras has enabled the observation of the cavitation dynamics. Without artificial light and with a speed of a thousand images per second, the development of the cavity during the revolution of the propeller can be recorded. This new technique was initially applied in the EC Growth project EROCAV, which studied large container vessels in a bid to investigate the aggressiveness of the erosion of the cavity implosion in a more reliable way.

A new state-of-the-art, high-speed video camera has been developed which is capable of shooting 5,000 images per second. The resolution and the light sensitivity of the camera is such that observations can be conducted using sunlight without artificial illumination. This very compact system also enables swift deployment of the equipment worldwide.

Dynamic behaviour

Although high-speed video has its roots in research applications, today the system is mostly deployed for navies, propeller manufacturers, shipowners and yards. Noise and vibrations, erosion of propeller or rudder, propulsion efficiency and inception speed assessment often require detailed observation of the propeller in service.

The next step in the whole research process to unravel the dynamic behaviour of the cavitation is a full-scale, high-speed video synchronised with high-frequency pressure measurement. This type of measurement is already performed at model-scale. Onboard, high-speed cavitation synchronised with pressure and vibration measurements will not only provide a better insight into the mechanism of propeller induced vibrations but it will also serve as a powerful tool in trouble-shooting activities.

To give an impression of the high-speed video the accompanying pictures are captured with a frame rate of 1,000 images per second in a bow thruster tunnel. The dynamics of the cavitation are already visible in the series of pictures, although a small movie gives a far better impression. MARIN