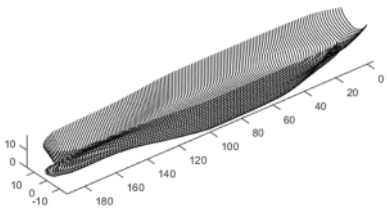
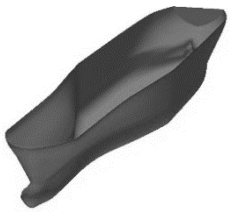
Second, through its unique morphing schemes, it was able to mix-and-match and modify existing solutions to create newer solutions automatically. These features are extremely useful as designers may now use MEC to carry out the initial optimisation for a design problem. This frees up time for them to focus on more important tasks which may otherwise not be afforded.

To demonstrate the complete design loop from the 3D CAD surface to discretised 2D offset data and vice-versa, the input data of the initial parent designs can also start from 3D CAD surfaces and convert to 2D offset points using hull-to-offset manager function in NAPA. The initial vessel model (container ship A) is in a 3D CAD format based on NURBS patch surfaces in NAPA. This surface is then discretised from 3D into 2D offset points using the hull-to-offset manager function in NAPA. The final output is a 2D representation of the same vessel in offset data format that is ready to be included in the hull form library for automatic HFDO using MEC. In a similar fashion, after completion of the HFDO process, the optimised hull form (from case study 1) which is in 2D offset format may also be converted back to 3D CAD format using the offset manager function in NAPA. By converting the optimised hull form back into 3D CAD format, it allows the 3D model to be validated using CFD.

To further demonstrate the usability of the 2D offset curve format, vessel geometries were compared with the 3D CAD surface (from the optimised child vessel in case study 1). The results are shown in Table 9.

Table 9: Comparison of vessel geometries, hydrostatics and performance of the optimised child vessel (solution 1189) for the 2D offset curve and 3D CAD surface format

Parameters	**2D offset curve**	**3D CAD surface**
Vessel model		
Principle dimensions (m)	185(Lpp) x 32(Breath) x 9 (Draught)	185(Lpp) x 32(Breath) x 9 (Draught)
Displacement (tonnes)	34460.16	33903.3