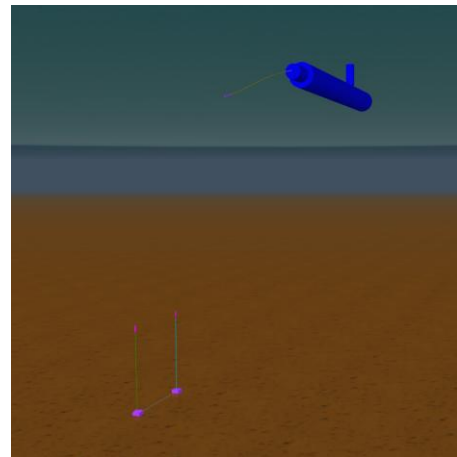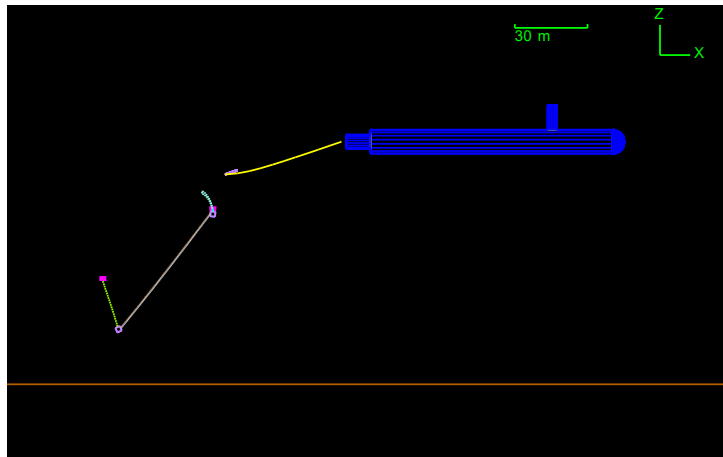# J01 Deployment with sub

Introduction

In this example, a submarine tows a sensor array before releasing components, in turn, to position them on the seabed.

Building the model

Ensure that *view by groups* is selected from the model browser (right-mouse click in the *model browser* to find this option).

Open the *Sub* group. This contains a vessel called *Submarine*. The vessel has shapes attached to give it a submarine shape.

Notice a padlock symbol by the shape *Hull*. This means it cannot accidently be moved by clicking and dragging it when building the model. You can *lock* and *unlock* by right-clicking on an object in the model browser, before selecting the desired option from the pop-up menu. Alternatively, you can simply left click once on an object in the model browser and use the keyboard shortcut *Ctrl+L*.

A line extends behind the vessel, *Subline*. The far end is attached to the release mechanism that consists of a *Deployer* (a 6D spar buoy) and two links. The links work to release the anchors.

Each sensor group contains an anchor, a float and a sensor line. A link holds the float close to the anchor while towing then releases on deployment.

A line (*Baseline*) also connects the two anchors together so that a required maximum separation is not exceeded.

The floats are modelled as 3D buoys, i.e. with translations only, because the detailed motions of the floats are not of interest.

The two anchors are modelled as lumped 6D buoys to better model interaction with the seabed, for example if one edge will contact first. Note that seabed contact occurs via the buoy vertices. A seabed friction coefficient of 0.2 has been applied and the contact area is set at $0.05m^2$ overall. This is applied equally between all the vertices. Only the bottom vertices will contact so the actual contact area will be $0.025m^2$.

If we had left the area as "~" then the overall contact area would have been determined from the buoy's volume divided by its height, i.e. $0.005m^3/1m = 0.005m^2$; meaning the contact area per vertex would be $0.0025m^2$, i.e. a 10th of what is actually needed.

The analysis is carried out in the following stages:

Stage	Vessel	Links	Time
0	Proceeds at 1.5m/s	–	-10sec to 0sec
1	Proceeds at 1.5m/s	1st anchor released so anchor and float sink towards seabed	0sec to 5sec
2	Proceeds at 1.5m/s	1st float released so rises up	5sec to 35sec
3	Proceeds at 1.5m/s	2nd anchor released so anchor and float sink towards seabed	35sec to 40sec
4	Proceeds at 1.5m/s	2nd float released so rises up	40sec to 100sec

A forward speed of 1.5m/s is specified in statics (set on the *general* data form, *statics* page), together with a small cross current. Corresponding hydrodynamic drag forces are then applied to the model when determining the initial static configuration. The transition to dynamics is then smooth, with no acceleration required.

We have used the explicit integration scheme to run this model, as the transients involved when the sensors are released mean that the implicit scheme needs to use a very short time step to run successfully. In these situations, the explicit scheme often runs more efficiently.

Results

View the simulation replay (*Ctrl+R*) through the whole simulation to see the deployment procedure.