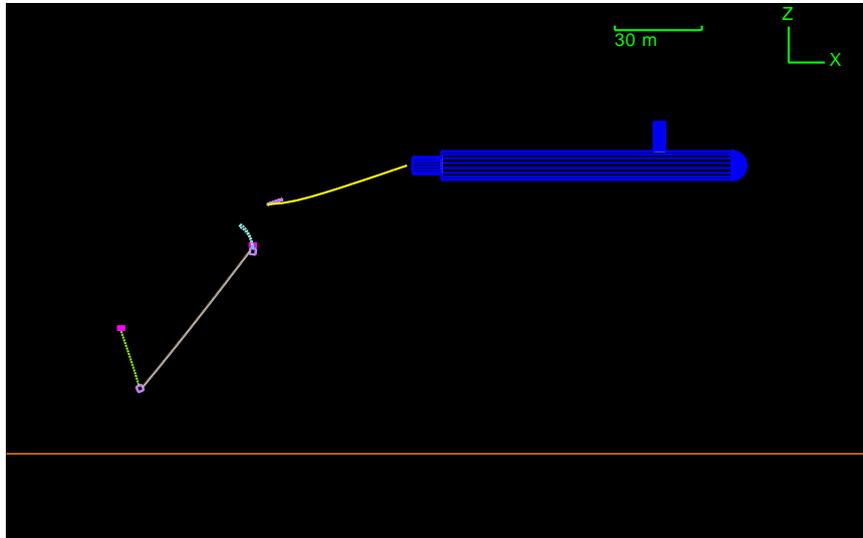# J01 Deployment with sub

Introduction

A submarine tows a sensor array. It releases components in turn to position them on the seabed.

Building the model

The system is to be installed using a submarine. With the model browser in *view by groups* mode, open the group *Sub*. This contains a vessel called *Submarine*. The vessel has shapes attached to give 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 an object via the right hand mouse button.

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. These links 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 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 so actual contact area of 0.0025m^2, which would have been a 10th of what was 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

Look at the animation through the whole simulation to see the deployment procedure.