hydrostatic rectangular barge

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1 Hydrostatics of a rectangular barge

This is a validation for the calculation of the hydrostatic properties of a rectangular shape. The shape is obtained from a panel mesh.

The values calculated by DAVE are compared with the analytical solution.

```
[1]: from DAVE import *
```

```
Equilibrium-core version = 1.0
default resource folders:
C:\Users\beneden\Miniconda3\envs\DAVE\lib\site-packages\DAVE\resources
C:\Users\beneden\DAVE_models
Blender found at: C:\Program Files\Blender Foundation\Blender 2.83\blender.exe
```

1.1 Input

Define the size of the barge

```
[2]: length = 100
     width = 20
     depth = 8
     draft = 4
```

Define the heel angle for numerical BM calculation

```
[3]: phi = 1  # degrees
```

1.2 Setup the model

```
[4]: s = Scene()
     vessel = s.new_axis('Vessel')

     # code for Buoyancy mesh
     mesh = s.new_buoyancy(name='Buoyancy mesh',
              parent='Vessel')
     mesh.trimesh.load_obj(s.get_resource_path(r'cube.obj'), scale =␣
      ↪(length,width,depth), rotation = (0.0,0.0,0.0), offset = (0.0,0.0,0.0))
```

Please update your version of pyo3d.

Update the state of the scene, this is required to force the calculation of the updated mesh. This is normally done automatically when solving statics, but we are not doing that here.

```
[5]: s.update()
```

Please update your version of pyo3d.

```
[6]: from DAVE.jupyter import *
show(s, camera_pos=(100,150,40))
```

```
embedWindow(verbose=True): could not load k3d module, try:
> pip install k3d       # and if necessary:
> conda install nodejs
```
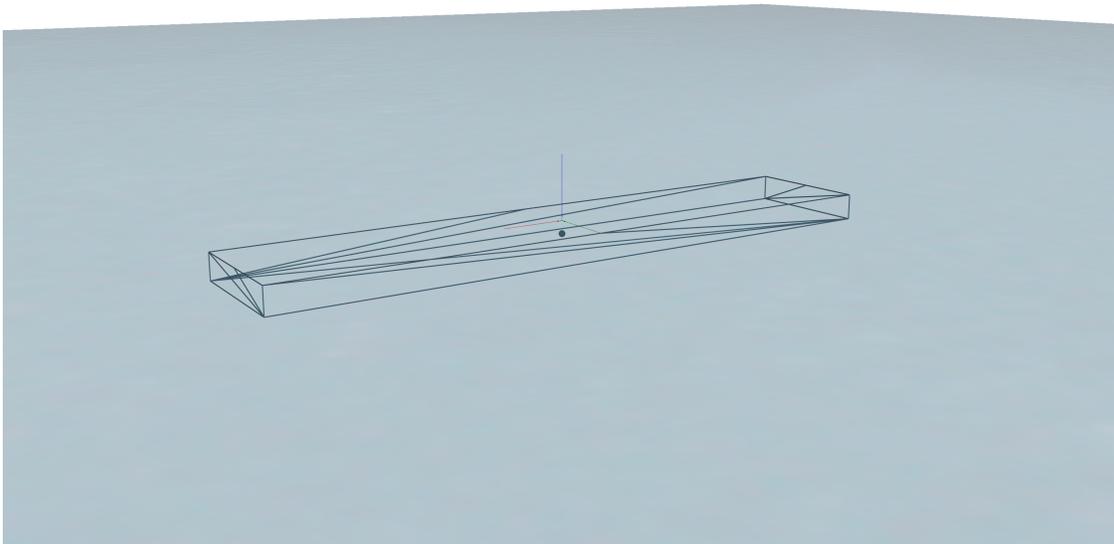

2 Checks

2.1 Displacement

The displacement $[m^3]$ should equal $length * width * draft$

```
[7]: expected_displacement = length * width * draft
```

```
[8]: print(f'Expected = {expected_displacement:.3f} \nActual = {mesh.displacement:.
     ↪3f}')
```

```
Expected = 8000.000
Actual = 8000.000
```

2.2 CoB

The CoB should be at 0,0,-0.5*draft

```
[9]: print(f'Expected = (0,0,-{0.5*draft:.3f})  \nActual = {mesh.cob}')
```

```
Expected = (0,0,-2.000)
Actual = (0.0, 0.0, -1.9999999999999998)
```

2.3 BM

The BM value is a linearized value for the stability. It describes the horizontal movement of the CoB as effect of a small heel angle. This relation is as follows:

$$\Delta CoB_y = BM \cdot sin(\phi)$$

where ϕ is small

The BM value can also be calculated as follows:

$$BM = \frac{I_{xx}}{displacement}$$

where

$$I_{xx} = \frac{1}{12} \cdot length \cdot width^3$$

```
[10]: Ixx = (1/12) * length * width**3
      displacement = length * width * draft
      BM_expected = Ixx / displacement
      print(f'BM_expected = {BM_expected:.3f}m')
```

```
BM_expected = 8.333m
```

```
[11]: coby0 = mesh.cob[1]
```

We need to rotate the vessel about its CoB. To easily do that we create a new axis system at the current cob postion, attach the vessel to that, and then rotate that new axis system.

```
[12]: driver = s.new_axis('heel_driver',position=mesh.cob)
      vessel.change_parent_to(driver)
      driver.rotation = (phi,0,0) # give the vessel a 1 degree positive heel angle
```

```
[13]: s.update()
      coby1 = mesh.cob[1]
```

```
Please update your version of pyo3d.
```

```
[14]: import numpy as np
      BM_calculated = -(coby1-coby0) /  np.sin(np.radians(1))
```

```
[15]: print(f'Expected = {BM_expected:.3f}m  \nActual = {BM_calculated:.3f}m')
```

```
Expected = 8.333m
Actual = 8.334m
```

— DONE —