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Miklós BALOGH and Josh DAVIDSON

Floating object tutorial – 2D

Assignments

Laboratory Session 8 Open-Source CFD Course 2021

Miklós BALOGH and Josh DAVIDSON

2021

2021

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Assignments

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2 Assignments

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Assignments

- Recall the floating object tutorial from last week's lab
- Suppose we want to investigate the effect of certain parameters on the result
 - The mesh resolution around the floating object and the free surface interface
 - Whether waves radiation from the floating object reflect off the side walls and influence the floating object motion
- The computational requirements/runtimes, of the numerous simulations required to investigate the effect of these parameters on the results, can be reduced by performing a "2D" simulation, where the domain is only 1 cell thick.



Tasks

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Assignments

- Make a copy of last week's free decay floatingObject case setup, run ./Allclean and then modify the case to make a 2D simulation
 - 1.1 system/blockMeshDict:
 - Change the width of the tank from 1m to 0.01m (Lines 23,24,27,28)
 - Set the number of cells in the y-direction to be 1 (Line 33)
 - Change the boundary condition on the front and back walls to empty (Lines 42-60)
 - 1.2 constant/topoSetDict
 - Change the y position of the floating object :(Line 24)
 - 1.3 constant/dynamicMeshDict
 - Change the width of the floating object :(Line 43)
 - 1.4 0/*
 - Change the boundary conditions for the front and back walls to empty (Line 33)



1.1 system/blockMeshDict

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Assignments

	Original
19 ver	tices
20 (
21	(0 0 0)
22	(100)
23	(1 1 0)
24	(0 1 0)
25	(0 0 1)
26	(1 0 1)
27	
20	(0 1 1)
29);	
21 61 6	eke.
32 /	icho
33	hex (0 1 2 3 4 5 6 7) (20 20 30) simpleGrading
34):	Her (0 1 2 0 1 0 0 1) (20 20 00) Simpleor during
35	
36 edg	es
37 (
38);	
39	
40 boi	undary
41 (
42	stationaryWalls
43	{
44	type wall;
45	Taces
46	
47	$(0 \ 3 \ 2 \ 1)$
48	(2 6 5 1)
49	(1 5 4 0)
51	(9 4 7 3)
52	(0475)
53	}
54	atmosphere
55	{
	•

Modified

	19 vert	tices
	20 (
	21	(0 0 0)
	22	(1 0 0)
	23	(1 0.01 0)
	24	(0 0.01 0)
	25	(0 0 1)
	26	$(1 \ 0 \ 1)$
	27	(1 0.01 1)
	28	(0 0.01 1)
	29);	
	30	
	31blog	:ks
	32 (
	33	hex (0 1 2 3 4 5 6 7) (20 1 30) simpleGrading (1 1 1)
	34):	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	35	
	36 edge	25 C
	37 (
	38):	
	39	
	40 bour	ndary
	41 (
	42	frontAndBack
	43	1
	44	type empty;
	45	faces
	46	(
	47	(1540)
	48	(3762)
	49);
	50	}
	51	stationaryWalls
	52	1
	53	type wall;
	54	faces
	55	(
	56	(0 3 2 1)
	57	(2 6 5 1)
	58	(0 4 7 3)
	59);
	60	}
	61	atmosphere
	62	LUCCORDER AND NO
		가 난 지 않다. 지 문 지 문 지 문 지 문 지 않는 것이
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1.2 system/topoSetDict

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Assignments

Original

L8 actions						
19 (
20 {						
21	name	cθ;				
22	type	cellSet;				
23	action	new;				
24	source	boxToCell;				
25	sourceI	nfo				
26	{					
27	box	(0.35 0.35	0.1)	(0.65	0.55	0.6);
28	}					
29 }						

Modified

18 actions					
19 (
20 {					
21	name c(9;			
22	type ce	ellSet;			
23	action ne	ew;			
24	source be	oxToCell;			
25	sourceInfo	D			
26	{				
27	box (0.35 0 0.1)	(0.65	0.01	0.6);
28	}				
29 }					

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1.3 constant/dynamicMeshDict

Solvers

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Assignments

Original

7	solver		27	solver
8	{		28	{
9	type Newmark:		29	type !
0	3		30	1 - 5,6-2.
1	,		31	1
2	accelerationRelayation R	7.	32	accelerati
2	decerer delonne cux delon o		32	acceteration
4	hadias		22	here all the set
2	boules		34	bodies
2	1		35	{
6	TLOATINGUDJect		36	float
7	{		37	{
8	type	cuboid;	38	ty
9	parent	root;	39	pa
0			40	
1	<pre>// Cuboid dimens</pre>	ions	41	1.
2	Lx	0.3:	42	i.
3	L v	0.2:	43	
4	-,	0.5	44	
5	E2	0.0,	45	L2
6	// Density of th	e cuboid	45	
7	77 Density of th	800.	40	
<i>.</i>	THU	000;	47	rr
8			48	
9	// Cubold mass		49	
0	mass	<pre>#calc "\$rho*\$Lx*\$Ly*\$Lz";</pre>	50	ma

Modified

{	type	Newmark	
}	cype	wewilding,	
acce	elera	tionRelaxation (9.7;
bodi	.es		
1	floa	tingObject	
		type	cuboid;
		parent	root;
		// Cuboid dimens	sions
		Lx	0.3;
		Ly	0.01;
		Lz	0.5;
		// Density of th	ne cuboid
		rho	800;
		// Cuboid mass	
		mass	<pre>#calc "\$rho*\$Lx*\$Ly*\$Lz";</pre>

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1.4 0/*

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Assignments

Add the boundary conditions for *frontAndBack* to all of the variables in the *0* folder



You can either do this one-by-one for each file, or use the following command to do every file automatically at once:

OpenF0AH/Lab_Week8/floating0bject2\$ cd 0
OpenF0AH/Lab_Week8/floating0bject2{0\$ sed -i s/"stationaryWalls"/"frontAndBack{ type empty; } stationaryWalls"/g

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Results

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Assignments

- 2.1 <u>Bonus mark</u> How much faster does the 2D simulation run than the 3D simulation in last week's lab session?
- 2.2 <u>Bonus mark</u> Reproduce the figures in the next two slides



alpha water at time = 5s



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Free decay results

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Tasks

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Assignments

2 Modify the tank geometry - *system/blockMeshDict*

- Increase the width of the tank to 4m : (Lines 21-28)
- Increase the depth of the tank to 2m : (Lines 21-24)
- Double the mesh density :(Line 33)
- Increase the mesh resolution around the body and the free surface interface
 - 3.1 system/topoSetDict
 - Rename topoSetDict to topoSetDict.1
 - Make 3 more copies of topoSetDict.1, rename them to topoSetDict.2, topoSetDict.3 and topoSetDict.4 and then modify them :(Line 27)
 - 3.2 system/refineMeshDict
 - Make the *refineMeshDict* file
 - 3.3 ./Allrun
 - Modify the Allrun file



2 system/blockMeshDict

Solvers	Original	Modified
Miklós B ALOGH and Josh DAVIDSON Floating object tutorial – 2D Assignments	19 vertices 20(21 (1 0 0) 23 (1 0.01 0) 24 (0 0.01 0) 25 (0 0 1) 26 (1 0 1) 27 (1 0.01 1) 28 (0 0.01 1) 29 (0 0.01 1) 30 blocks 32 (33 hex (0 1 2 3 4 5 6 7) (20 1 30) simpleGrading (1 1 1) 34); 35 of eiges 37 (1 38); 39	19yertices 20((-1.5 0 -1) 22 (2.5 0 -1) 23 (2.5 0 -1) 23 (2.5 0 -1) 25 (-1.5 0 -1) 26 (2.5 0 -1) 27 (2.5 0 -1) 27 (2.5 0 -1) 28 (3 - hex (0 1 2 3 4 5 6 7) (100 1 120) simpleGrading (1 1 1) 33) 33) 34) 33) 33) 33) 33) 33
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3.1 system/topoSetDict.1

Solvers				
Miklós ALOGH and Josh AVIDSON				
ating ect orial – 2D	18 action	15		
signments	19 (20 { 21 22 23 24 25 25 26	name type action source sourceIn {	c0; cellSet; new; boxToCell; ifo	
	27 28 29 } 30	box }	(0.35 0 0.1)	(0.65 0.01 0.6);
	31 { 32 33 34 35 } 36);	name type action	c0; cellSet; invert;	

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3.1 system/topoSetDict.2

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Assignments

8 Foar	mFil	е				
9{						
10	ver	sion	2.0;			
11	for	nat	ascii;			
12	cla	55	dictionary	;		
13	obj	ect	topoSetDic	t;		
14 }						
15 //	* * :	* * * *	* * * * * *	* * *	* * *	***
16						
17 act	ions					
18 (
19	{					
20		name	cΘ;			
21		type	cellSet;			
22		action	new;			
23		source	boxToCell;			
24		box	(0.25 0 0)	(0.75	0.01	0.7);
25	}					
26						
27	{					
28		name	сθ;			
29		type	cellSet;			
30		action	invert;			
31	}					
32);						

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3.1 system/topoSetDict.3

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Assignments

8 Foar	nFil	е	
9 {			
10	ver	sion	2.0;
11	for	nat	ascii;
12	cla	5 S	dictionary;
13	obj	ect	topoSetDict;
14 }			
15// 3	* * :	* * * * *	* * * * * * * * * * * * * * * * * * *
16			
17 act:	ions		
18 (
19	{		
20		name	c0;
21		type	cellSet;
22		action	new;
23		source	boxToCell;
24		box	(-100 -100 0.45) (0.25 100 0.6);
25	}		
26			
27	{		
28		name	cθ;
29		type	cellSet;
30		action	invert;
31	}		
32);			
22			

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3.1 system/topoSetDict.4

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Assignments

8	FoamFile						
9	{						
10		vers	sion	2.0:			
11		format		ascii:			
12		class		dictionary:			
13		object		topoSetDict:			
14	}			,			
15	11 *	 * > 	* * * *)	* * * * * * * * * * * * * * * * * *			
16							
17	17 actions						
18	(
19		{					
20			name	c0;			
21			type	cellSet;			
22			action	new;			
23			source	boxToCell;			
24			box	(0.75 -100 0.45) (100 100 0.6);			
25		}					
26							
27		{					
28			name	cθ;			
29			type	cellSet;			
30			action	invert;			
31		}					
32);						
133							

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3.2 system/refineMeshDict

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Assignments

8 Foar 9 (nFile						
10	version	2.0:					
11	format	ascii:					
12	class	dictionary:					
13	location	"system":					
14	object	refineMeshDict:					
15.}	00,000						
16//	*****	*******					
17							
18 set		c0:					
19							
20 cooi	rdinateSvste	n global:					
21	,	5 .					
22 glob	balCoeffs						
23 {							
24	tan1	(0 0 1);					
25	tan2	(100);					
26 }							
27							
28							
29 directions							
30 (
31	tan1						
32	tan2						
33);							
34							
35 useł	HexTopology	no;					
36							
37 geon	netricCut	yes;					
38							
39writ	eMesh	no;					
			이 문 에 이 문어				

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3.3 ./Allrun

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Assignments

1#!/hin/sh 2 cd \${0%/*} || exit 1 # Run from this directory 4# Source tutorial run functions 5. \$WM PROJECT DIR/bin/tools/RunFunctions 7# Set application name 8 application=\$(getApplication) 10#Create the background mesh for tank and floating object 11 runApplication blockMesh 12 cp system/topoSetDict.1 system/topoSetDict 13 topoSet > log.topoSet1 14 runApplication subsetMesh -overwrite c0 -patch floatingObject -noFields 15#Refine the mesh around the body and the free surface interface 16 cp system/topoSetDict.2 system/topoSetDict 17 topoSet > log.topoSet2 18 refineMesh -overwrite > log.refineMesh1 19 cp system/topoSetDict.3 system/topoSetDict 20 topoSet > log.topoSet3 21 refineMesh -overwrite > log.refineMesh2 22 cp system/topoSetDict.4 system/topoSetDict 23 topoSet > log.topoSet4 24 refineMesh -overwrite > log.refineMesh3 25#Set the fields and run the simulation 26 runApplication setFields 27 runApplication sapplication

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Results

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Assignments

- **Bonus mark** How many cells are used in this simulation?
- Bonus mark Reproduce the figures in the next two slides



Mesh at time = 0s

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Assignments



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Free decay results



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Assignments

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Assignments

<u>3 Bonus marks</u> - Using the files and boundary conditions from the tutorial *multiphase/interFoam/laminar/waves/stokesl*, further modify the *floatingObject* case from this lab session, to drive the motion of the floating object with waves created from the boundary