

# Evoker: a scalable web-GUI visualizer and mesh generator

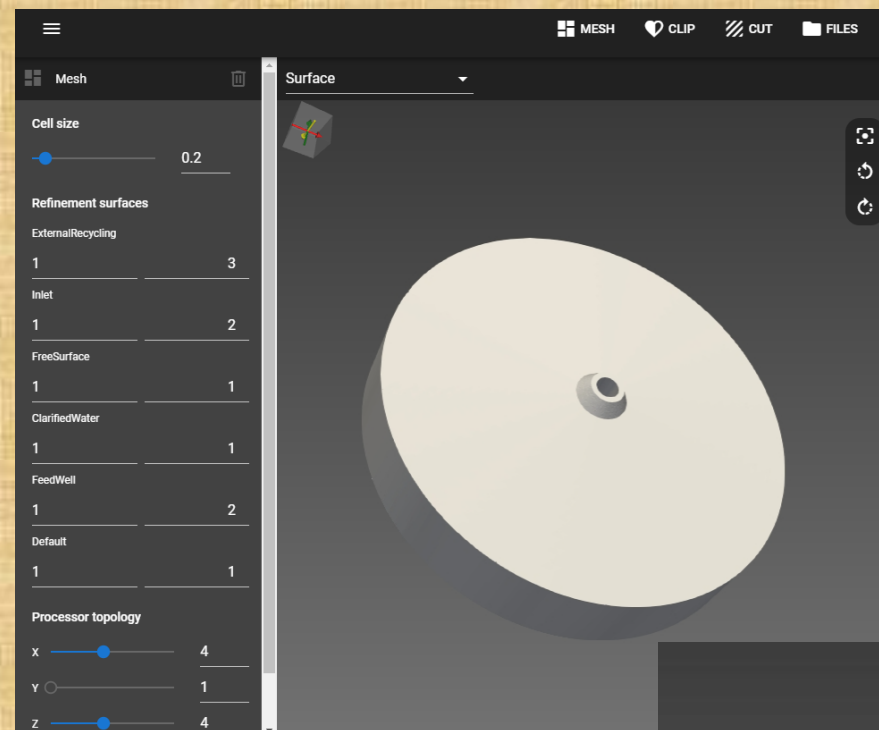
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**Coordinating professor:** Josep Jorba Esteve

**Area of the FMP:** High-Performance Computing

**Date of Delivery:** June 2021



Context



## Context and justification

Fourth industrial revolution:

- Internet of things.
- Simulation: Computational Fluid Dynamics (CFD).
- Cloud computing.
- Additive Manufacturing.

## Meshing: introduction

- CFD solves fluid dynamics problems (openFOAM).
- Meshing to discretize the physical domain.
- Meshing is computer-intensive.
- Not many tools with GUI, not to mention web-based.

## Objectives

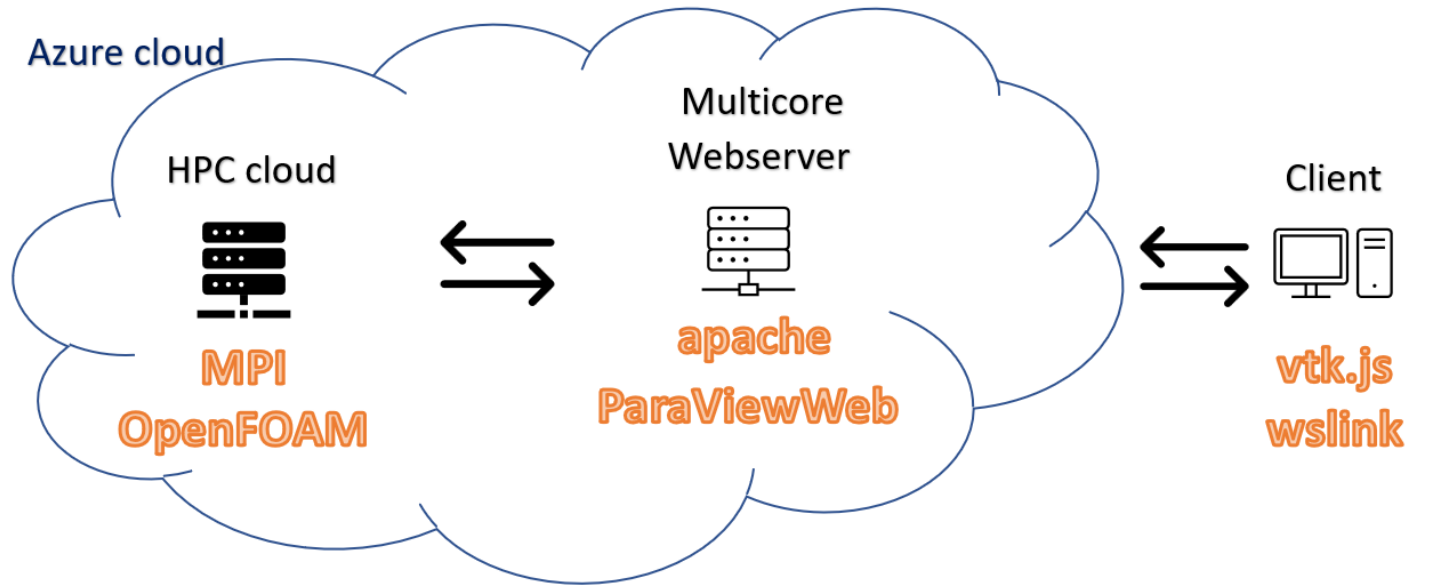
- 3D scientific visualizer.
- Can run on mobile devices.
- Web front-end for mesh tuning.
- Meshing functionality scalable in an HPC cloud.

Software ecosystem

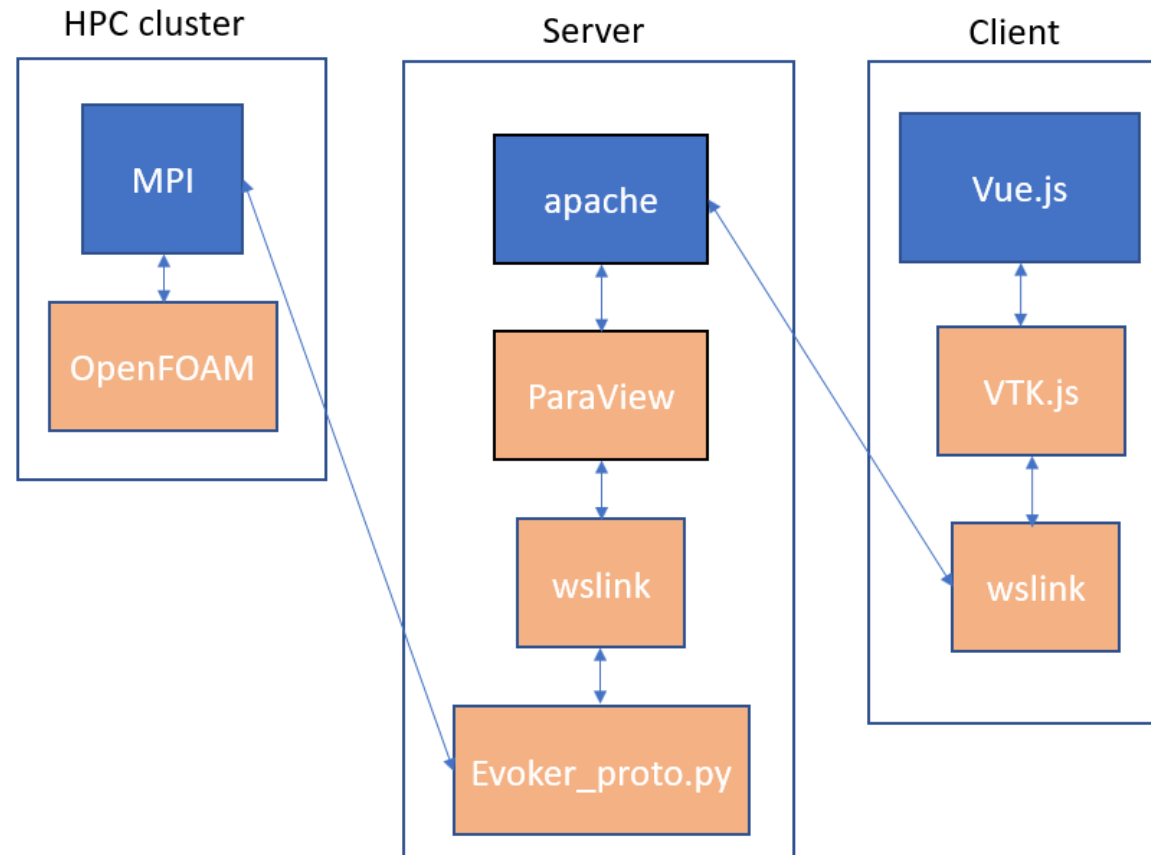
A white, torn-paper-like border runs along the bottom edge of the slide, starting from the left and curving upwards towards the right. The rest of the slide is solid black.

# Technologies 1/2

- VTK.js.
- ParaView.
- WebSockets.
- Vue.js.
- Azure.

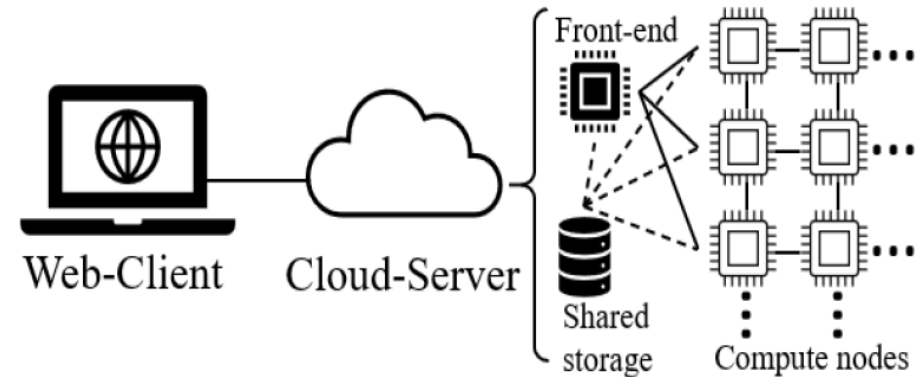
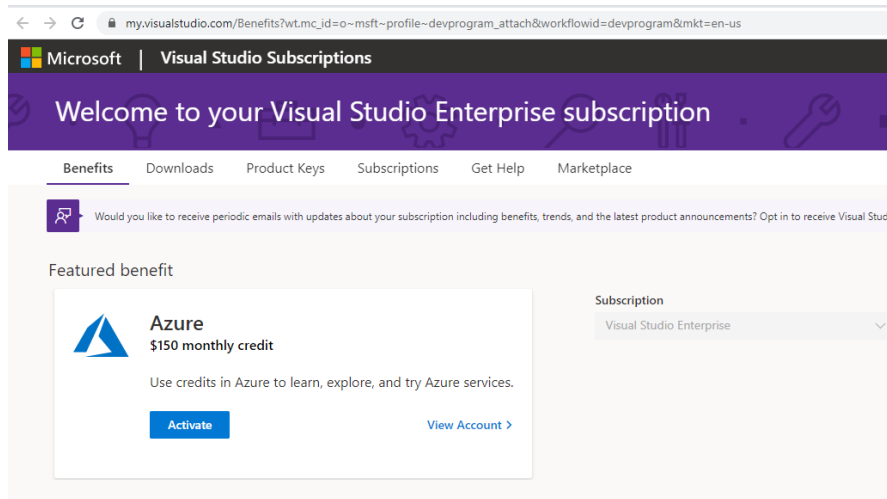


# Technologies 2/2





# Azure cloud 1/2



# Azure cloud 2/2

Microsoft Azure  📧 🗨️ 🔔 ⚙️ ? 😊

## Azure services



Create a  
resource



Cost  
Management ...



Storage  
accounts



Virtual  
machines



Help + support



All resources



Load balancers










Kubernetes  
services



Subscriptions

## Recent resources

Name	Type	Last Viewed
 Visual Studio Enterprise Subscription	Subscription	13 hours ago
 ViewerServer	Virtual machine	13 hours ago
 OpenFoam2	Virtual machine	a month ago
 OpenFoam1	Virtual machine	a month ago
 OpenFoam3	Virtual machine	a month ago
 OpenFoam4	Virtual machine	2 months ago
 evokerstorageuser	Storage account	2 months ago

Visualization



## 3D visualization server setup

Install binaries:

- ParaView.
- node.js.
- git clone <https://github.com/FrancescSM/evoker.git>
- install app dependencies and build.
- install and configure apache.

# 3D scientific visualization demo

The screenshot shows a presentation slide titled "3D scientific visualization demo". The slide content includes:

- A central terminal window showing a file explorer view of a directory. The files listed are:

Name	Size (KB)
..	
case-base	
case-base_ori	
decantador	
decantador_english	
manco_agitador-TFM	
march	
march_ori	
Grafite.obj	44 510
Serpentine01A.stl	142 074
Serpentine05.stl	108 440
- To the right of the terminal, a diagram shows a "Client" (represented by a monitor and server icon) connected to "vtk.js" and "wslink" (represented by orange text).
- The background of the slide is a blurred image of a virtual desktop environment. It shows a terminal window with the command `./run_shared.sh` and a file explorer window showing the same directory as the terminal. A small circular inset in the bottom left corner shows a video feed of a person wearing glasses and a headset.

# Meshing

A decorative white torn paper effect runs horizontally across the bottom of the slide, with irregular, jagged edges that create a layered, paper-like appearance.

## **Evoker = ParaView customization + openFOAM meshing**

- Adaptation of ParaView Lite to Evoker.
- Meshing workflow.

## Meshing: files preparation

Evoker reads and/or writes four files:

- **blockMeshDict**: boundary surfaces, \$Nodes
- **decomposeParDict**: processes's topology
- **snappyHexMeshDict**: refinement surfaces
- **UISettings**: resolution, nodes, topologies, iterations



# Meshing demo

Home - Microsoft Azure

portalazure.com/#home

Microsoft Azure

Search resources, services, and docs (G+)

francescc@hp.com  
HP INC. (@FROMMICROSOFT.COM)

### Azure services

- Create a resource
- Cost Management
- Storage accounts
- Virtual machines
- Help + support
- All resources
- Load balancers
- Kubernetes services
- Subscriptions
- More services

### Recent resources

Name	Type	Last Viewed
OpenFoam1	Virtual machine	3 minutes ago
ViewerServer	Virtual machine	3 minutes ago
OpenFoam3	Virtual machine	16 minutes ago
OpenFoam4	Virtual machine	53 minutes ago
OpenFoam2	Virtual machine	53 minutes ago
Visual Studio Enterprise Subscription	Subscription	3 days ago
evokerstorageuser	Storage account	2 months ago
openfoam3_nic	Network interface	2 months ago
openfoam4_nic	Network interface	2 months ago
openfoam3_ip	Public IP address	2 months ago
openfoam2_nic	Network interface	2 months ago
openfoam1_ip	Public IP address	2 months ago

### Navigate

- Subscriptions
- Resource groups
- All resources
- Dashboard

### Tools

- Microsoft Learn
- Azure Monitor
- Security Center
- Cost Management

5:00

7:42 PM 6/3/2021

# Performance analysis



## Hardware used

- **Main server** (apache+ParaView):  
Ubuntu 18.04-LTS 16 vcpus, 128 GiB RAM.
- **HPC nodes**:  
Ubuntu 18.04-LTS 4 vcpus, 32 GiB RAM.

# Results: Visualization performance in the client (1/2)

Name	S...	93% CPU	72% Memory	5% Disk	28% Network	10% GPU	GPU engine	Power usage	Power usage t...
Google Chrome (12)		0.1%	244.0 MB	0 MB/s	0 Mbps	0%	GPU 1 - 3D	Very low	Low
Google Chrome		0%	8.0 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	7.9 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	12.3 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	1.7 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	42.5 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	11.3 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	4.5 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	58.5 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	9.3 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	6.4 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0%	9.1 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Google Chrome		0.1%	72.6 MB	0 MB/s	0 Mbps	0%		Very low	Very low

# Results: Visualization performance in the client (2/2)

```

Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit

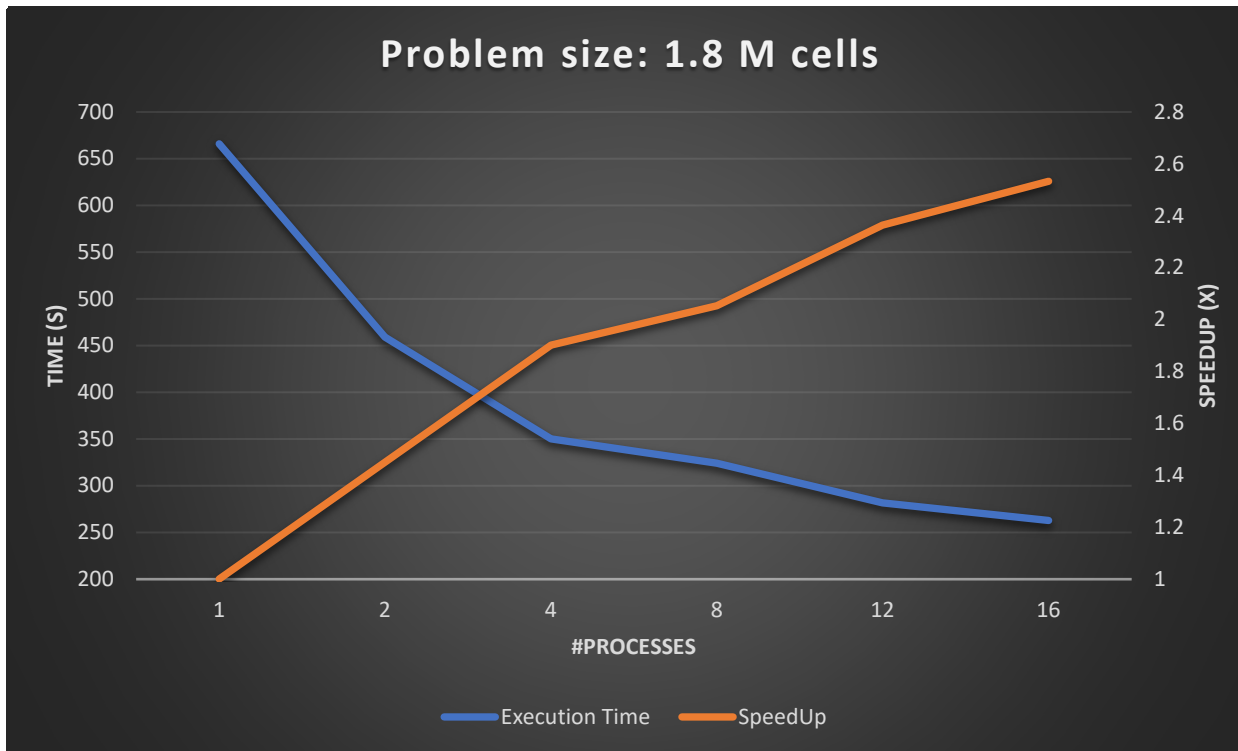
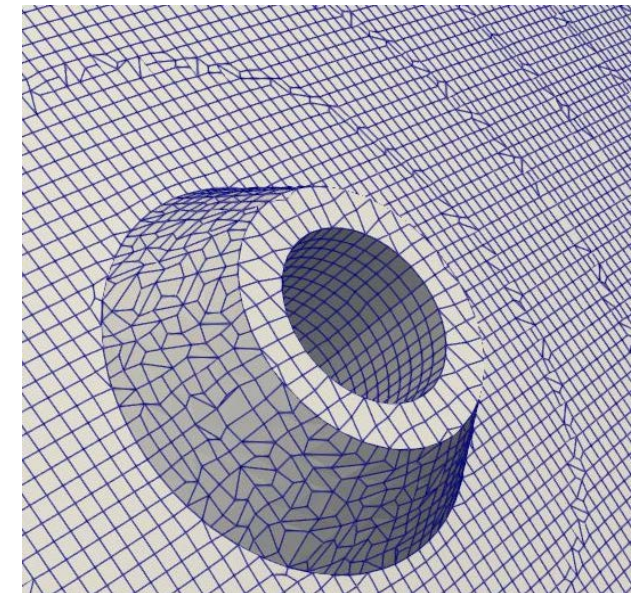
Quick connect...
1 [|||||] 7.4% 5 [|||||] 7.9% 9 [|||||] 20.1% 13 [|||||] 20.9%
2 [|||||] 7.3% 6 [|||||] 6.7% 10 [|||||] 6.1% 14 [|||||] 7.3%
3 [|||||] 30.0% 7 [|||||] 11.3% 11 [|||||] 15.2% 15 [|||||] 35.9%
4 [|||||] 6.0% 8 [|||||] 7.3% 12 [|||||] 7.3% 16 [|||||] 6.8%
Mem [|||||] 1.18G/126G Tasks: 50, 107 thr, 199 kthr; 16 running
Swp [|||||] 0K/0K Load average: 0.47 0.13 0.04
Uptime: 01:11:57

PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
2951 azureuser 20 0 4520M 916M 154M S 220.0 0.7 4:36.45 pvpython --force-offscreen-rendering /home/azureuser
2955 azureuser 20 0 4520M 916M 154M R 8.7 0.7 0:10.08 pvpython --force-offscreen-rendering /home/azureuser
2960 azureuser 20 0 4520M 916M 154M R 8.7 0.7 0:09.85 pvpython --force-offscreen-rendering /home/azureuser
2967 azureuser 20 0 4520M 916M 154M R 8.7 0.7 0:09.78 pvpython --force-offscreen-rendering /home/azureuser
2961 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.86 pvpython --force-offscreen-rendering /home/azureuser
2956 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.95 pvpython --force-offscreen-rendering /home/azureuser
2958 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.93 pvpython --force-offscreen-rendering /home/azureuser
2962 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.86 pvpython --force-offscreen-rendering /home/azureuser
2963 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.80 pvpython --force-offscreen-rendering /home/azureuser
2965 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.80 pvpython --force-offscreen-rendering /home/azureuser
2969 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.67 pvpython --force-offscreen-rendering /home/azureuser
2968 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.69 pvpython --force-offscreen-rendering /home/azureuser
2970 azureuser 20 0 4520M 916M 154M R 8.0 0.7 0:09.56 pvpython --force-offscreen-rendering /home/azureuser
2959 azureuser 20 0 4520M 916M 154M R 7.3 0.7 0:09.87 pvpython --force-offscreen-rendering /home/azureuser
2964 azureuser 20 0 4520M 916M 154M R 7.3 0.7 0:09.84 pvpython --force-offscreen-rendering /home/azureuser
2966 azureuser 20 0 4520M 916M 154M R 7.3 0.7 0:09.77 pvpython --force-offscreen-rendering /home/azureuser
4004 azureuser 20 0 33060 5292 3652 R 1.3 0.0 0:00.42 htop
2953 azureuser 20 0 4520M 916M 154M S 0.0 0.7 0:00.63 pvpython --force-offscreen-rendering /home/azureuser
1641 root 20 0 379M 26660 10164 S 0.0 0.0 0:07.09 python3 -u bin/WALinuxAgent-2.2.54.2-py2.7.egg -run
2954 azureuser 20 0 4520M 916M 154M S 0.0 0.7 0:00.60 pvpython --force-offscreen-rendering /home/azureuser
11 root 20 0 0 0 0 I 0.0 0.0 0:00.50 rcu_sched
2952 azureuser 20 0 4520M 916M 154M S 0.0 0.7 0:00.59 pvpython --force-offscreen-rendering /home/azureuser
3639 azureuser 20 0 105M 4996 3848 S 0.0 0.0 0:00.03 sshd: azureuser@pts/1
2839 root 20 0 0 0 0 I 0.0 0.0 0:00.47 kworker/u32:1-mlx5_cmd_6d84:00:02.0
355 root 20 0 0 0 0 I 0.0 0.0 0:00.05 kworker/12:1-mm_percpu_wq
3430 root 20 0 0 0 0 I 0.0 0.0 0:00.06 kworker/u32:2-events_power_efficient
884 root 20 0 0 0 0 I 0.0 0.0 0:00.07 kworker/1:2-events
1769 root 20 0 379M 26660 10164 S 0.0 0.0 0:00.60 python3 -u bin/WALinuxAgent-2.2.54.2-py2.7.egg -run
1284 messagebu 20 0 50096 4516 3796 S 0.0 0.0 0:00.27 /usr/bin/dbus-daemon --system --address=systemd: --
736 root 20 0 14200 2900 1892 S 0.0 0.0 0:01.54 /usr/lib/linux-tools/5.4.0-1046-azure/hv_kv_daemon
1 root 20 0 77972 8920 6540 S 0.0 0.0 0:02.34 /sbin/init
1043 systemd-r 20 0 70656 5072 4512 S 0.0 0.0 0:00.38 /lib/systemd/systemd-resolved
1203 syslog 20 0 263M 4168 3624 S 0.0 0.0 0:00.21 /usr/sbin/rsyslogd -n
1770 root 20 0 379M 26660 10164 S 0.0 0.0 0:00.13 python3 -u bin/WALinuxAgent-2.2.54.2-py2.7.egg -run
1938 root 20 0 105M 7176 6160 S 0.0 0.0 0:00.02 sshd: azureuser [priv]
2229 azureuser 20 0 105M 5044 3904 S 0.0 0.0 0:00.03 sshd: azureuser@pts/0
2 root 20 0 0 0 0 S 0.0 0.0 0:00.00 kthreadd
3 root 0 -20 0 0 0 I 0.0 0.0 0:00.00 rcu_gp
4 root 0 -20 0 0 0 I 0.0 0.0 0:00.00 rcu_par_gp
6 root 0 -20 0 0 0 I 0.0 0.0 0:00.00 kworker/0:0H-kblockd
9 root 0 -20 0 0 0 I 0.0 0.0 0:00.00 mm_percpu_wq

```

# Results: Meshing performance

Topology	1 node		2 nodes		3 nodes		4 nodes		Optimum	
	ppn	Time(s)	ppn	Time(s)	ppn	Time(s)	ppn	Time(s)	Time(s)	SpeedUp
1x1x1	1	665.75							665.75	1
2x1x1	2	459.02	1	549					459.02	1.45
2x1x2	4	456.15	2	350.17	2	355.42			350.17	1.9
4x1x2			4	326.65	3	324.18			324.18	2.05
4x1x3					3	281.55			281.55	2.36
4x1x4							4	262.9	262.9	2.53



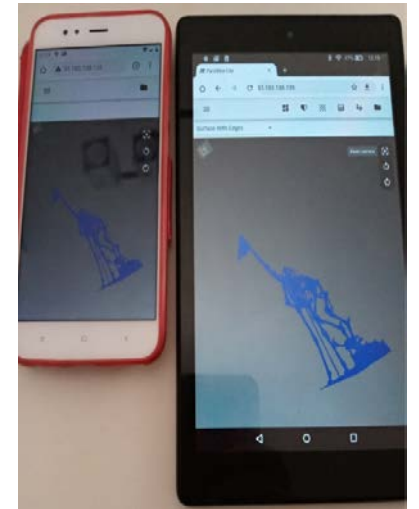
# Conclusions





## Conclusions

- The solution offers a good visualization experience even in low-performance devices.
- The meshing functionality can scale up and down considering the problem size, the resource requirements, and the budget limitations.
- Evoker has been found useful for increasing productivity in meshing tasks in targeted problems as demonstrated by a paper being accepted as Short Paper in SIMULTECH 2021.





Thank you!

A white, torn paper effect runs horizontally across the bottom of the slide, with a jagged, irregular edge that gives the impression of a piece of paper being pulled away from a black background.