EuroHack 18
Team OXIM

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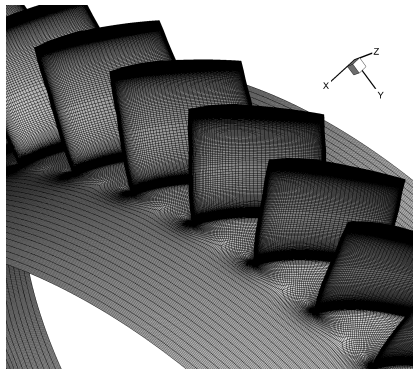
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AU3X

- cell-centred finite volume on unstructured grids

- implicit and explicit time-integration schemes.

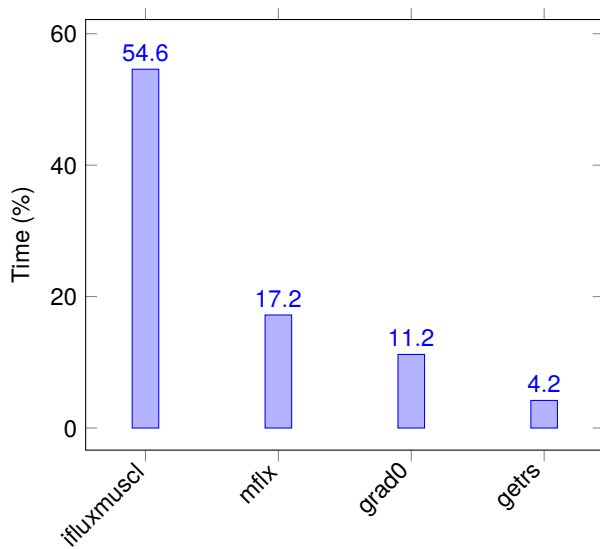- LES and RANS capability.

- Fourier-based methods.
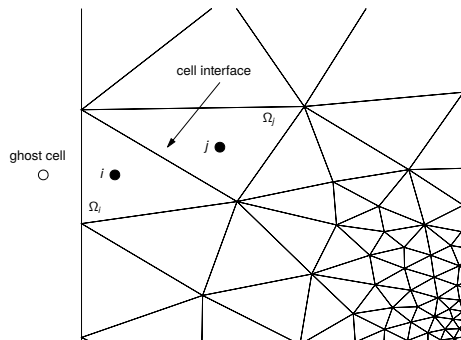
Test case

- NASA ROTOR37

- Full annulus (coarse) 8 million DOFs

- 3-stage Runge Kutta (explicit)
- Roe's approximate Riemann solver
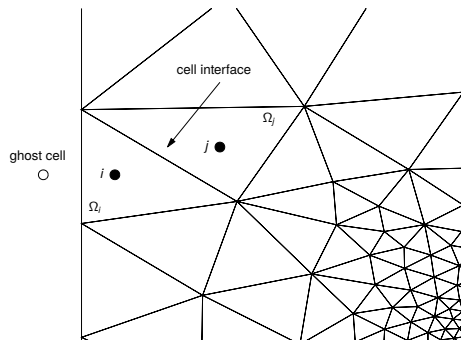
- 2nd order TVD MUSCL scheme

Computational profile

Computational kernels
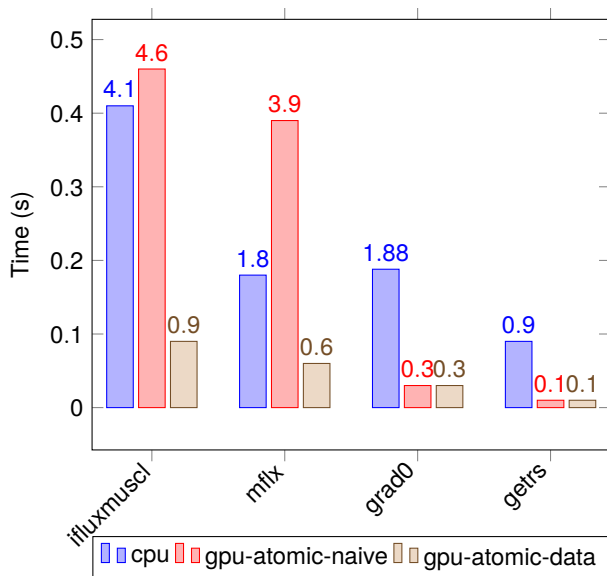
face-based kernel

```
1  for( ic=ics;ic<ice;ic++ )
2  {
3      i1= indx[0][ic];
4      i2= indx[1][ic];
5
6      u1= q[i1];
7      u2= q[i2];
8      f = geo[ic]*(u2-u1);
9
10     res[i1]-= f;
11     res[i2]+= f;
12 }
```
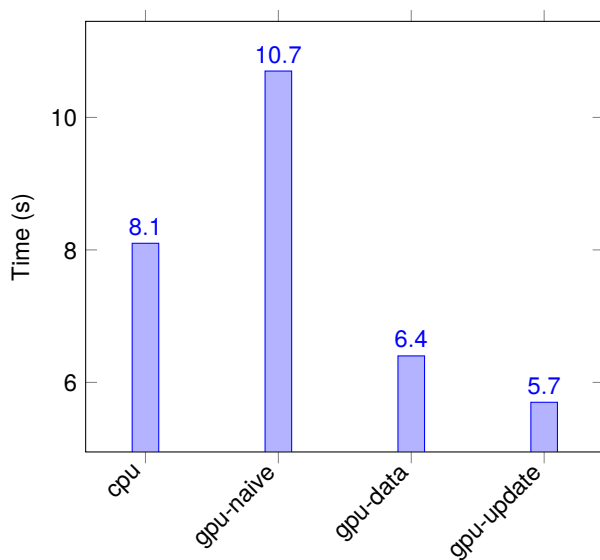
cell-based kernel

```
1  for( iq=iqs;iq<iqe;iq++ )
2  {
3      q[iq]+= dq[iq];
4  }
```


cell interface

Ω_j

ghost cell
○

i ●

j ●

Ω_i

Results (kernels)

Results (solver)

Conclusions

- 42% speed-up of the whole solver compared to a full socket HSW E5-2690 v3 (12 MPI ranks)

- for the actual kernels, speed-ups range between 3X and 9X compared to a full socket.

- we are also limited by Amdahl's law since we only ported 80% of the solver on the GPU.

- more work needed to explore async kernel calls, move boundary computation on the GPU.

- found a possible bug in PGI 18.7 where this portion of code generates illegal memory references

```
1 for( ia=5;ia<5;ia++ )
2 {
3      f[ia]= 0.5*( fr[ia]+ fl[ia]- fa[ia] )*wc[3*nfc+ic];
4      rhs[ia*nq+iql]-= f[ia];
5      rhs[ia*nq+iqr]+= f[ia];
6 }
```