Variable resolution in DualSPHysics: developments and applications

Francesco Ricci

SUMMARY

REFERENCES

SCIENTIFIC ARTICLES

- **Ricci, Francesco, Renato Vacondio, and Angelantonio Tafuni.** "Multiscale smoothed particle hydrodynamics based on a domain-decomposition strategy." Computer Methods in Applied Mechanics and Engineering (2024).
- **Ricci, Francesco, Renato Vacondio, and Angelantonio Tafuni.** "Three-dimensional variable resolution for multi-scale modeling in Smoothed Particle Hydrodynamics." Computer Physics Communications (2025).

DOCUMENTATION

- **Guide:** in doc/guides/XML_GUIDE_VRESOLUTION.pdf
- **Examples:** examples/vresolution

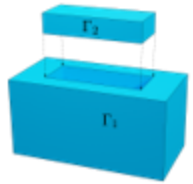
SUPPORT

- https://github.com/DualSPHysics/DualSPHysics/issues

THEORY

VARIABLE RESOLUTION ALGORITHM

1. Computational domain is partitioned in sub-domains, each with its own resolution.



APPLICATIONS

FLOW PAST A CYLINDER

WAVES

MOVING OBJECTS

COUPLING WITH OTHER METHODS

FUTURE OUTLOOK

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NEW IN V6.0 BETA

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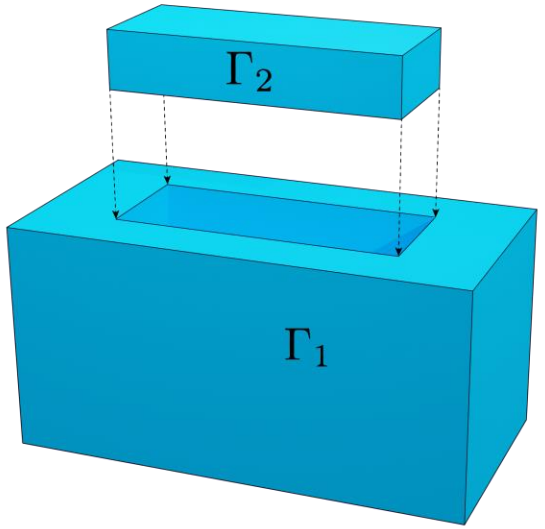

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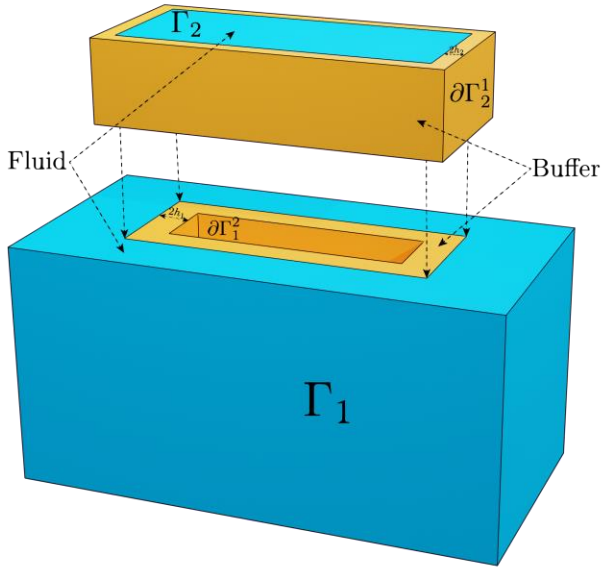
2. Each sub-domain is extended by a buffer region, populated by buffer particles.



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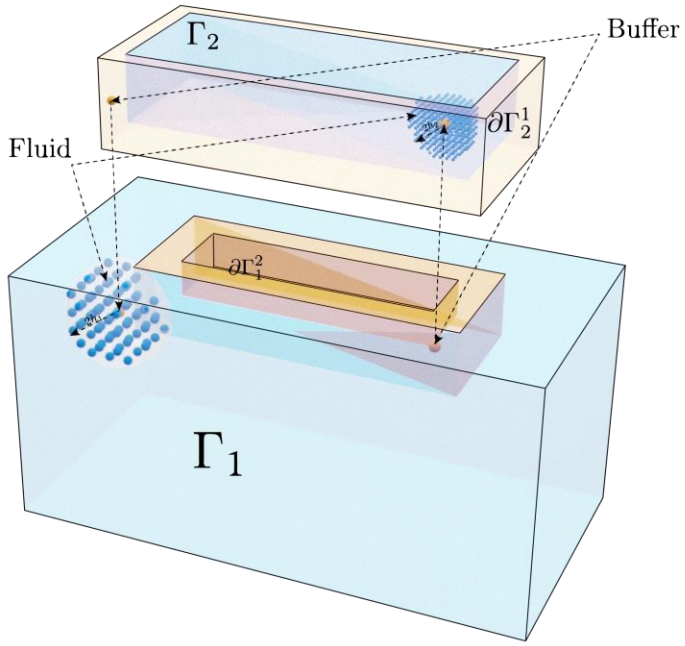
VARIABLE RESOLUTION ALGORITHM

1. Computational domain is partitioned in sub-domains, each with its own resolution.

2. Each sub-domain is extended by a buffer region, populated by buffer particles.

3. This buffer particles obtain their physical properties from coupled(adjacent) sub-domain and enforce Dirichlet BC.



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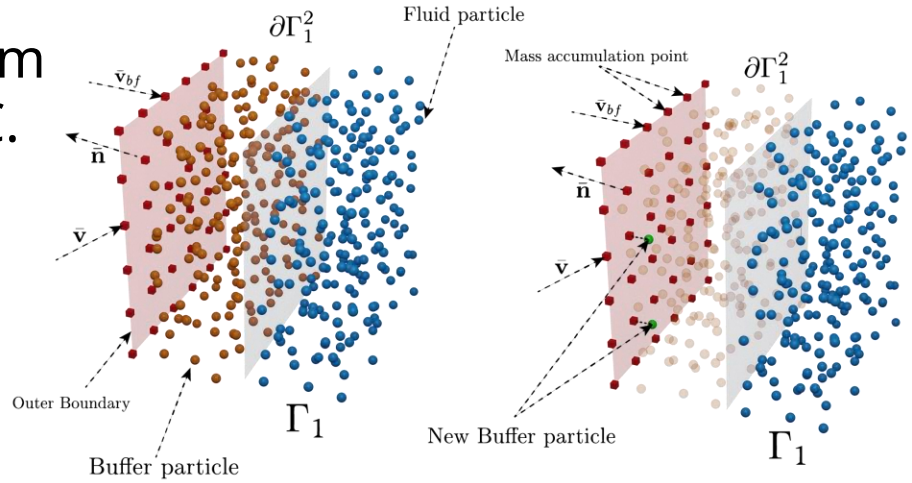
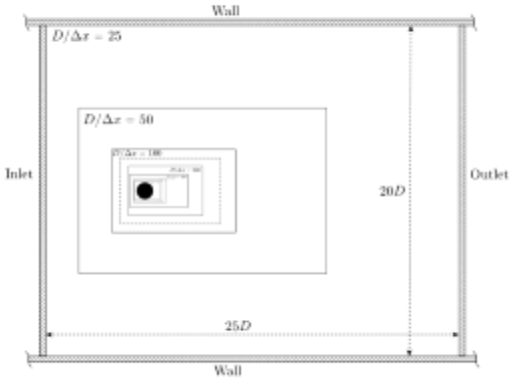
4. Transfer of mass between sub-domain is calculated by means of the eulerian flux at points on the sub-domain limits.



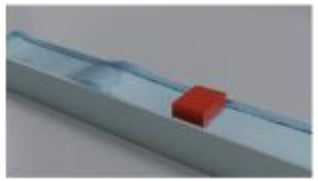
APPLICATIONS

FLOW PAST A CYLINDER



WAVES

(PLEASE USE ADVANCED SHIFTING!)

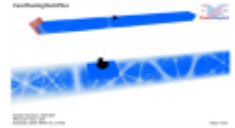


MOVING OBJECTS

FALLING WEDGE

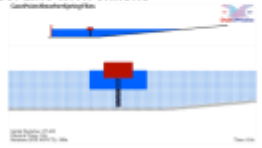
MOVING CYLINDER IN TANDEM

FLOATING OBJECT

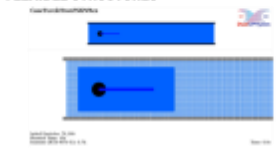


COUPLING WITH OTHER METHODS

COUPLING WITH CHRONO



FLEXIBLE STRUCTURES



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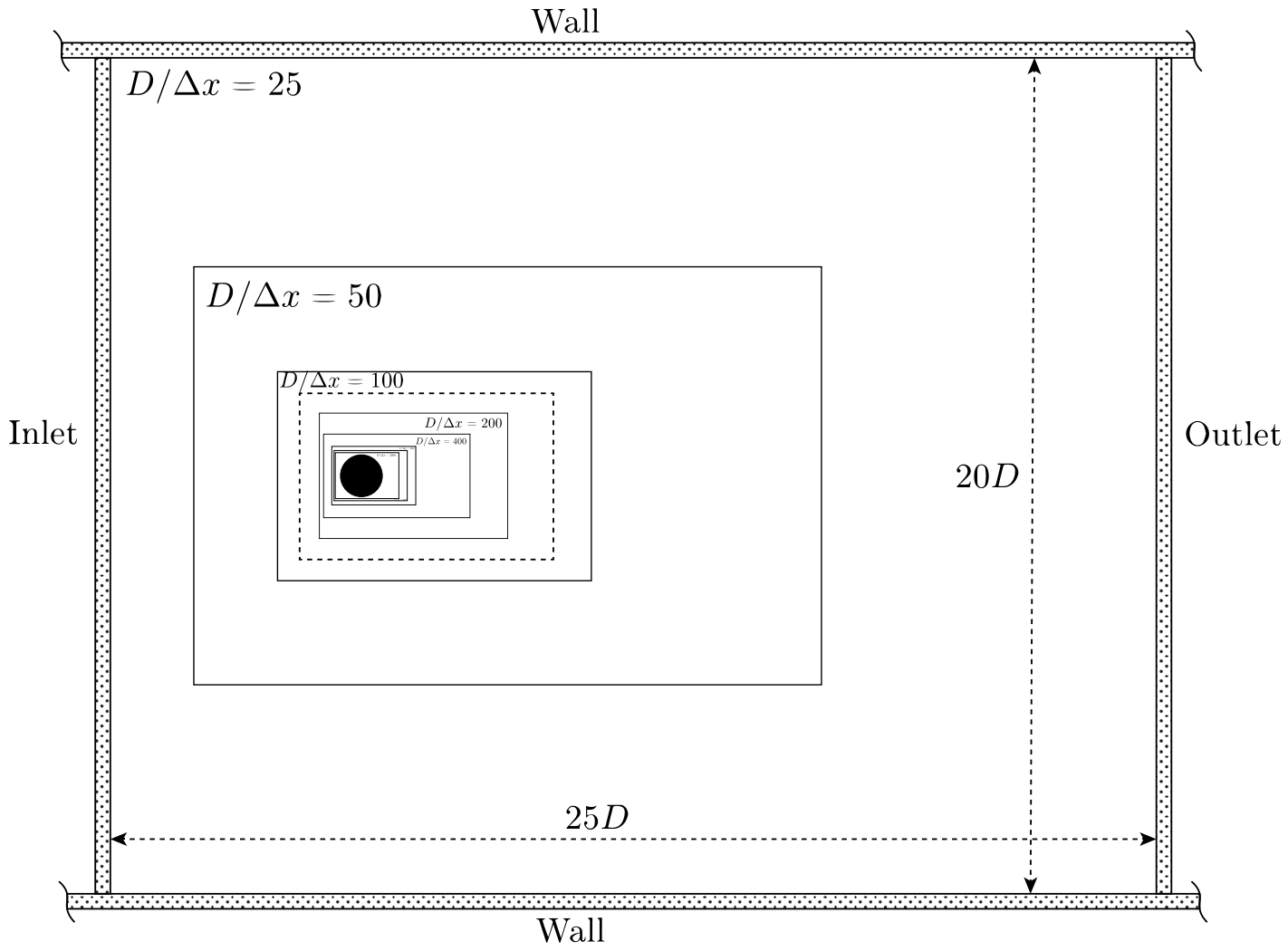

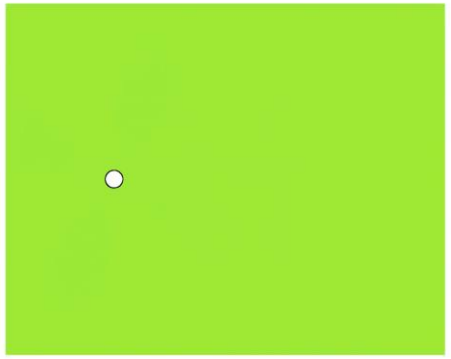

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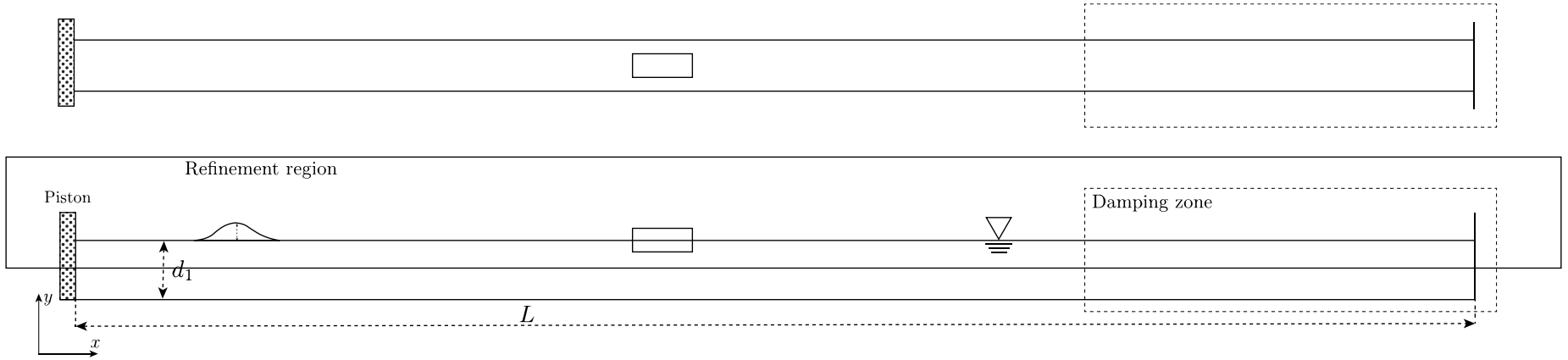

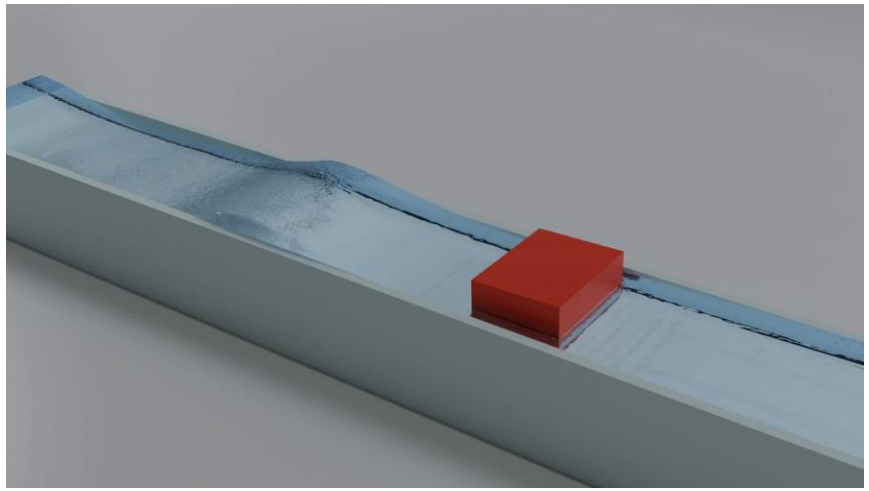

WAVES

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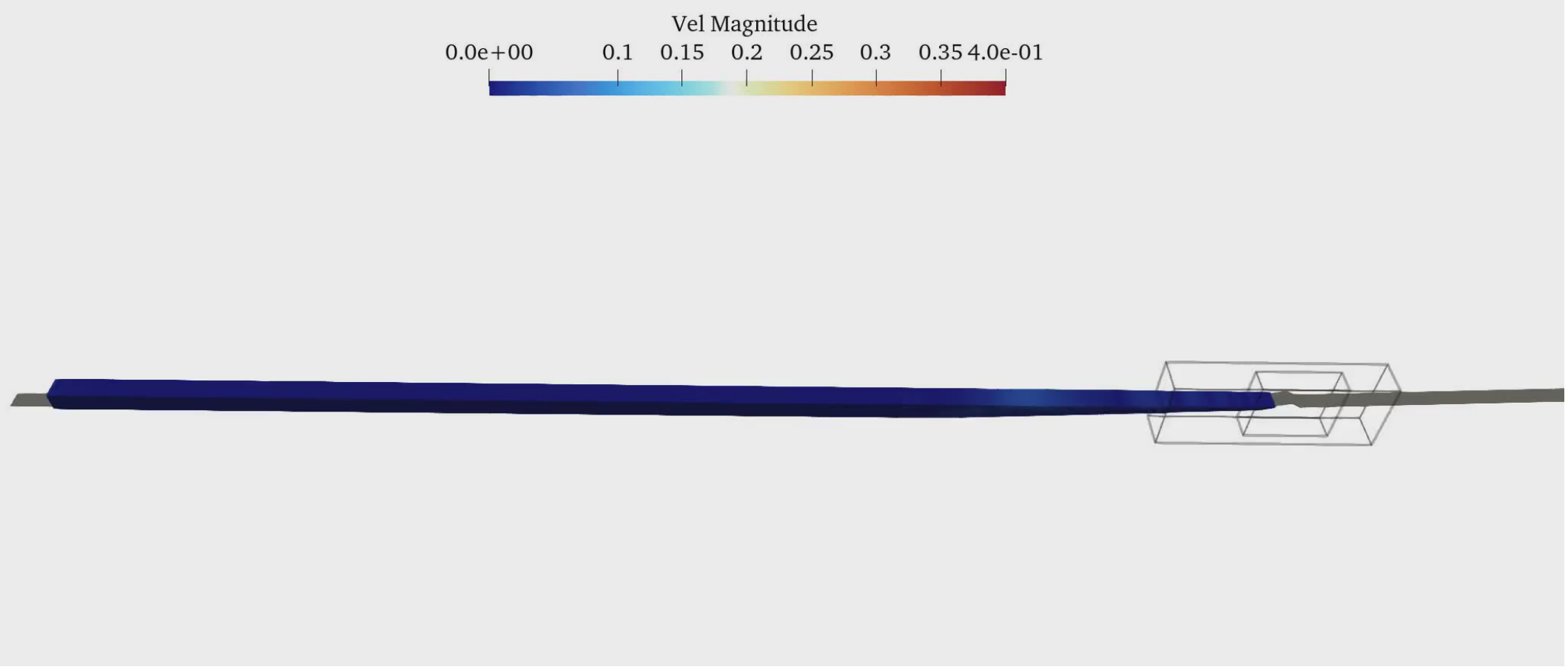
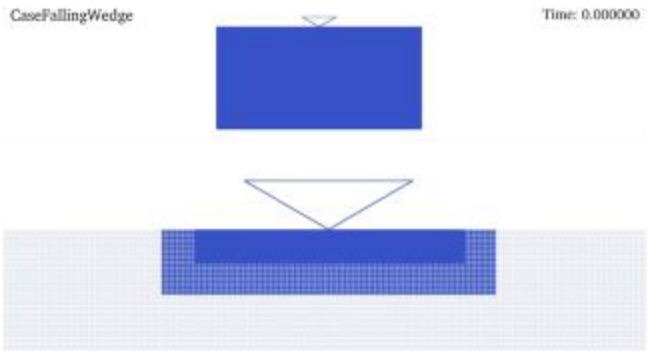
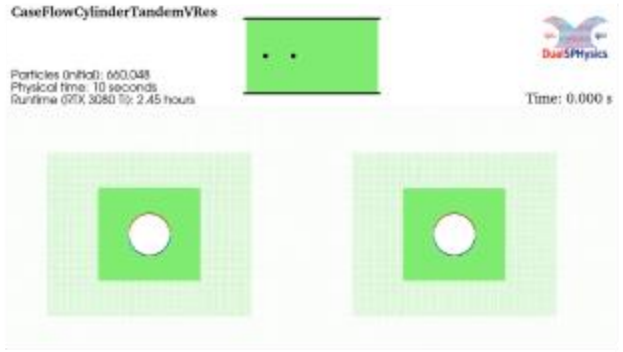


MOVING OBJECTS

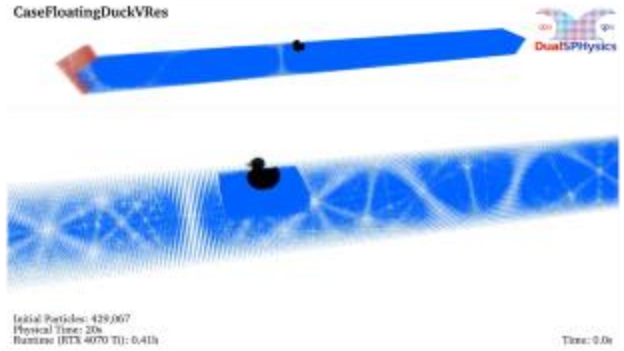
FALLING WEDGE



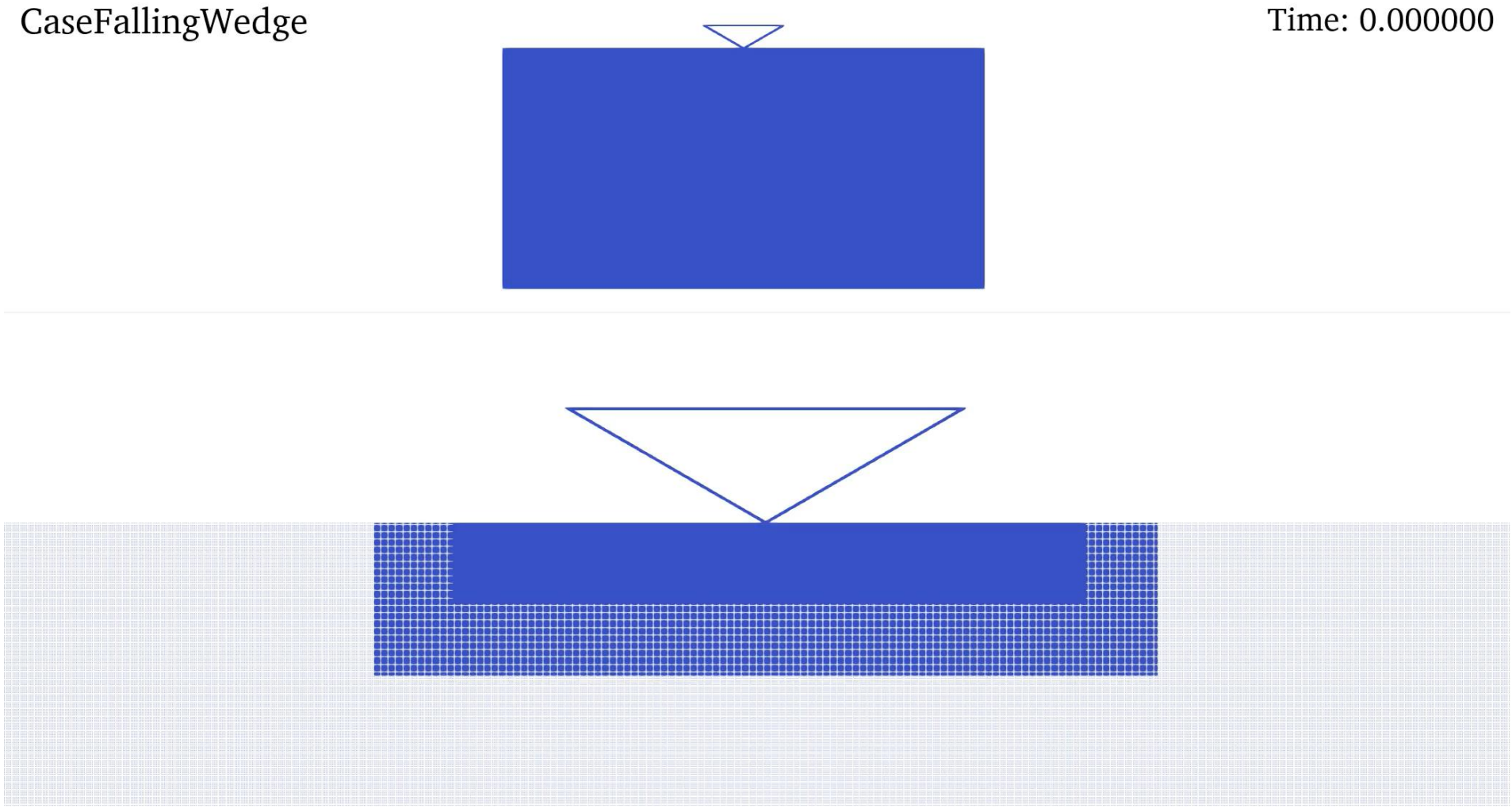
MOVING CYLINDER IN TANDEM



FLOATING OBJECT

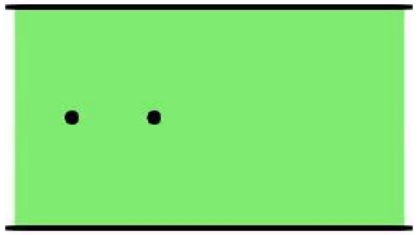


FALLING WEDGE



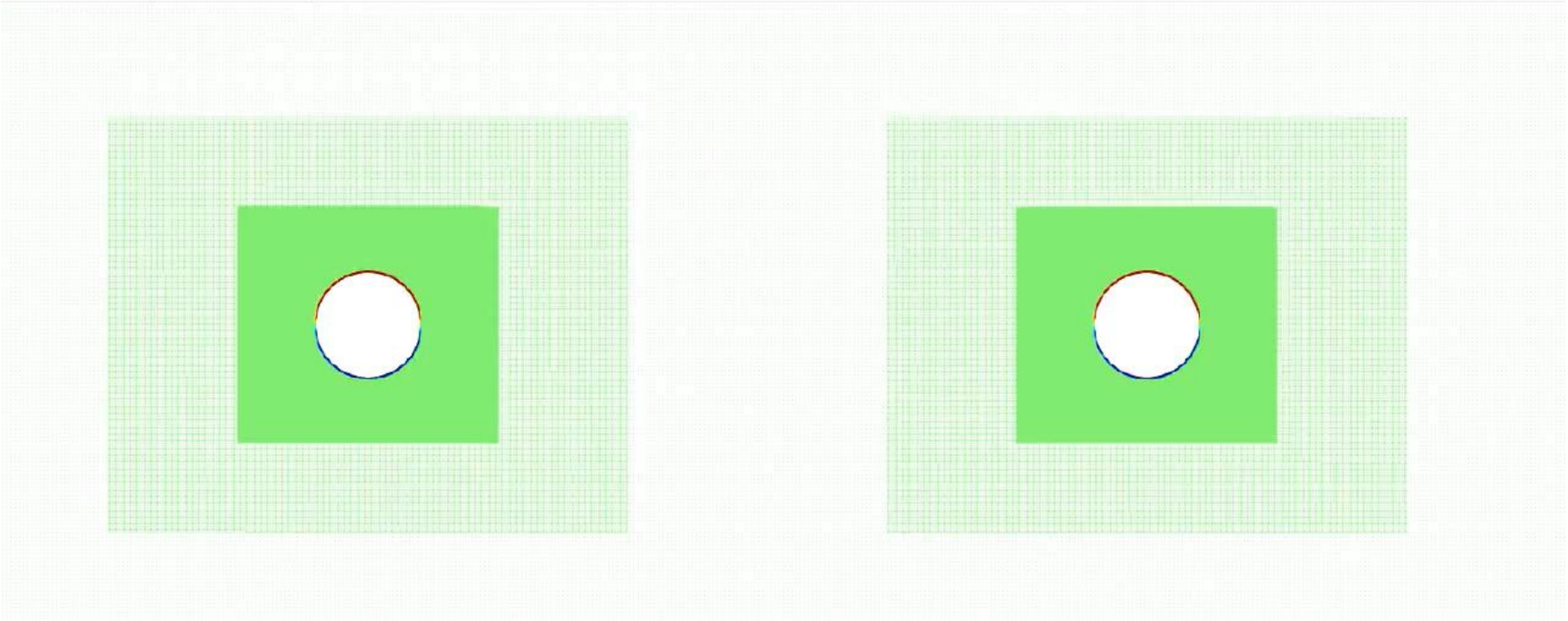
MOVING CYLINDER IN TANDEM

CaseFlowCylinderTandemVRes



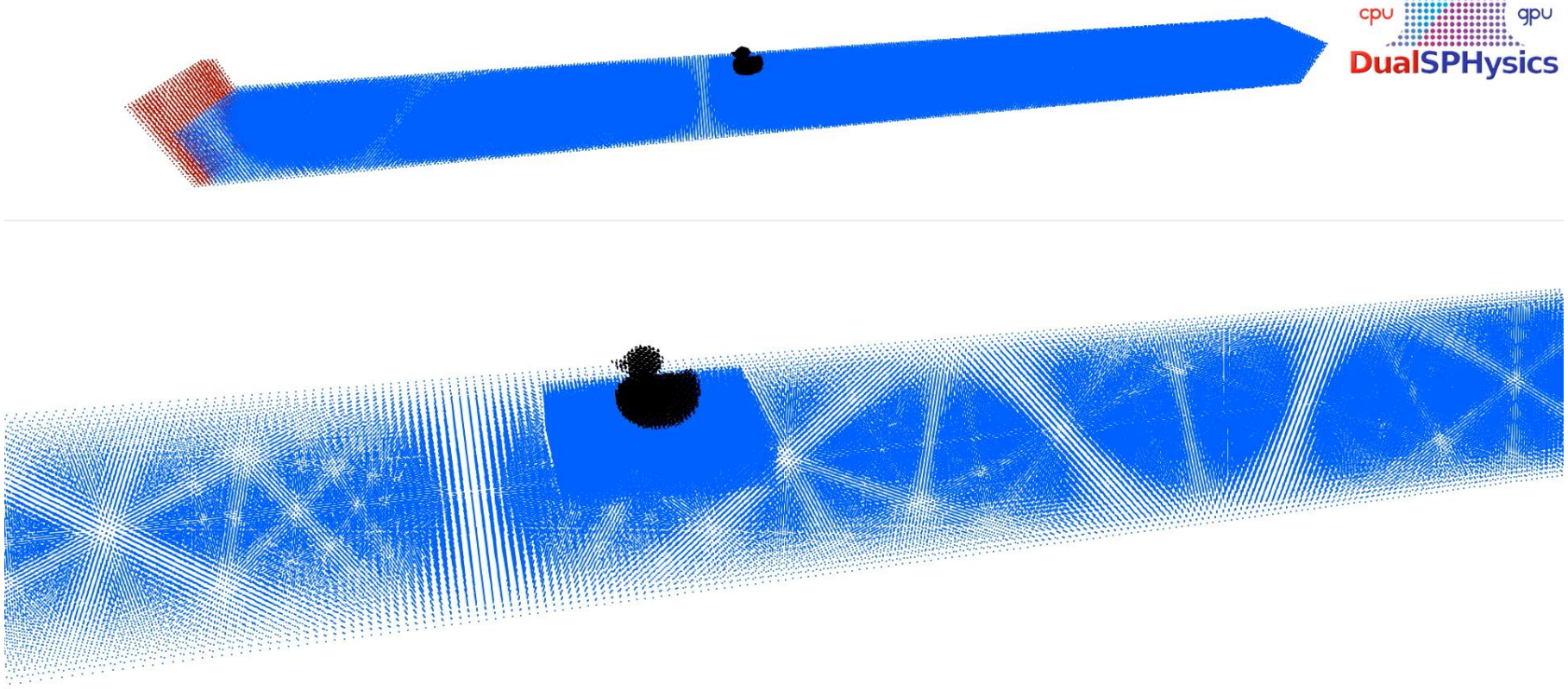
Particles (initial): 660,048
Physical time: 10 seconds
Runtime (RTX 3080 Ti): 2.45 hours

Time: 0.000 s



FLOATING OBJECT

CaseFloatingDuckVRes

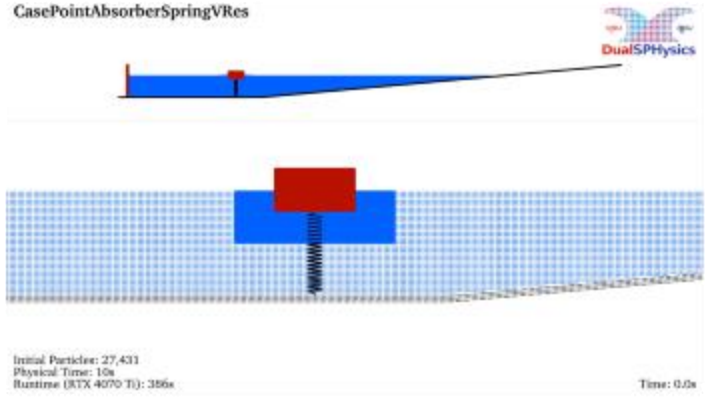


Initial Particles: 429,067
Physical Time: 20s
Runtime (RTX 4070 Ti): 0.41h

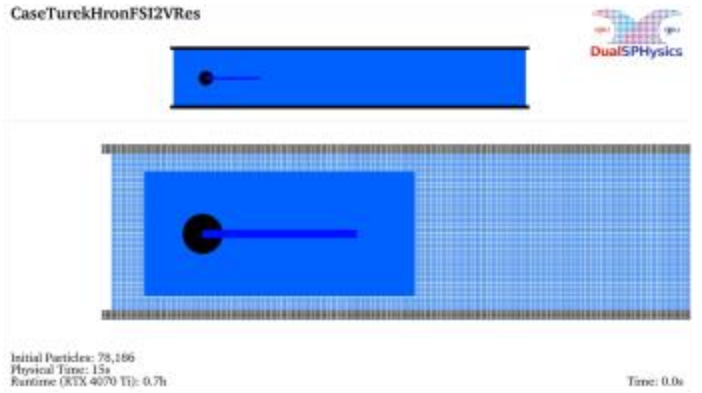
Time: 0.0s

COUPLING WITH OTHER METHODS

COUPLING WITH CHRONO

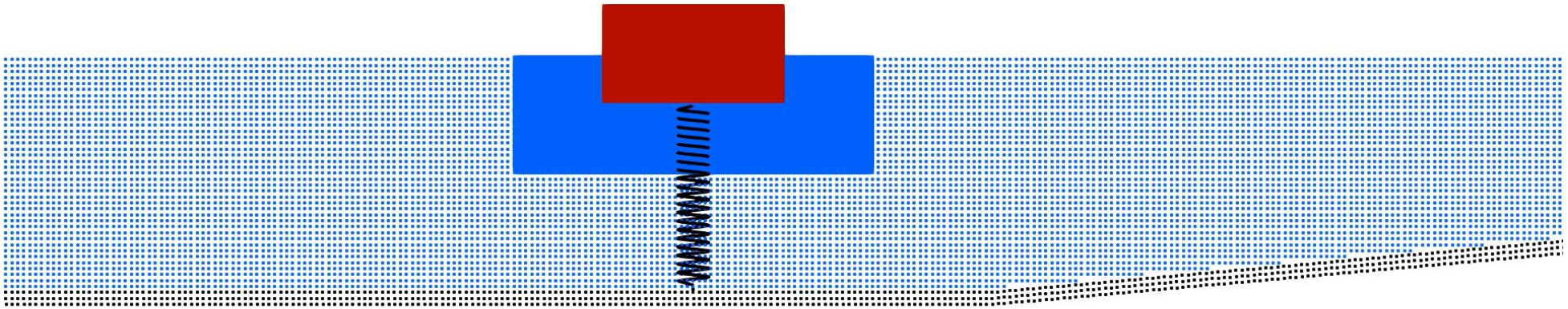


FLEXIBLE STRUCTURES



COUPLING WITH CHRONO

CasePointAbsorberSpringVRes

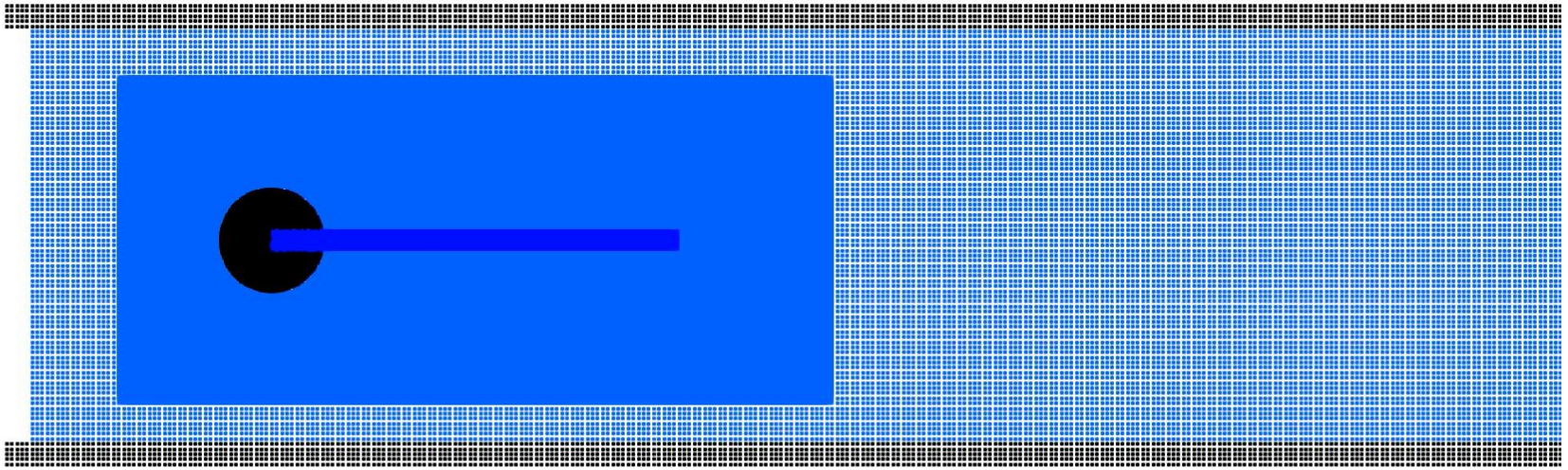


Initial Particles: 27,431
Physical Time: 10s
Runtime (RTX 4070 Ti): 386s

Time: 0.0s

FLEXIBLE STRUCTURES

CaseTurekHronFSI2VRes



Initial Particles: 78,186
Physical Time: 15s
Runtime (RTX 4070 Ti): 0.7h

Time: 0.0s

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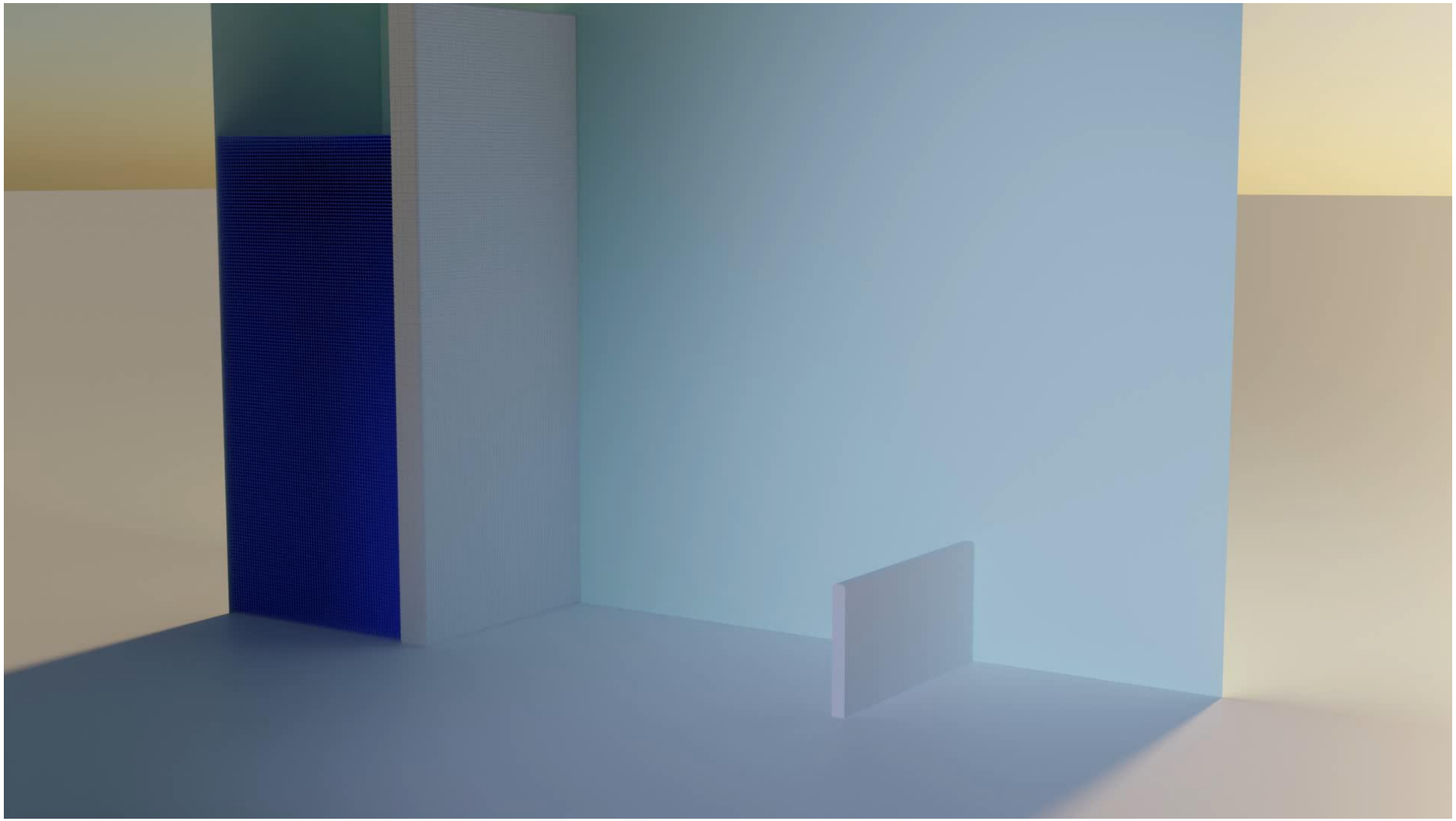

FUTURE OUTLOOK