

Shallow water / rigid body simulation

Physically-based Simulation course project 2013

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Project idea

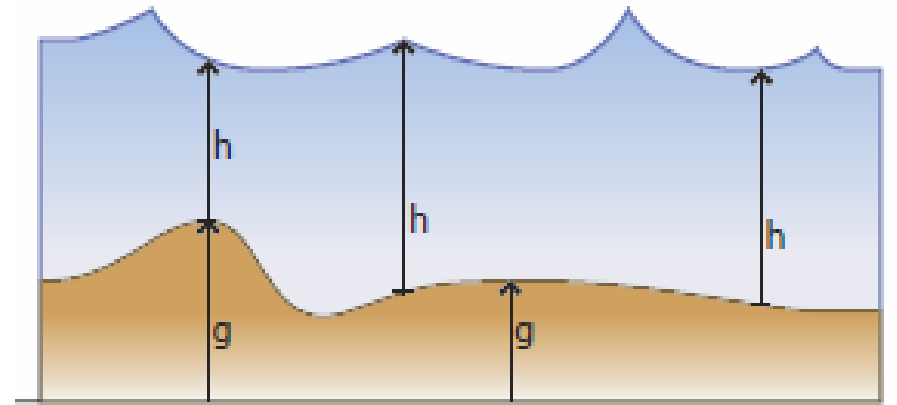
- Shallow water simulation
- Interaction water / rigid body
- Real time rendering
- User can move the rigid body
- User can influence the water (rain, waves,..)

Shallow Water Equations (SWE)

- Derived from conservation of mass and momentum
- Assumption pressure is hydrostatic implies:
 - Fluid surface can be represented by a heightfield
 - Velocity $\mathbf{v} \in \mathbb{R}^2$

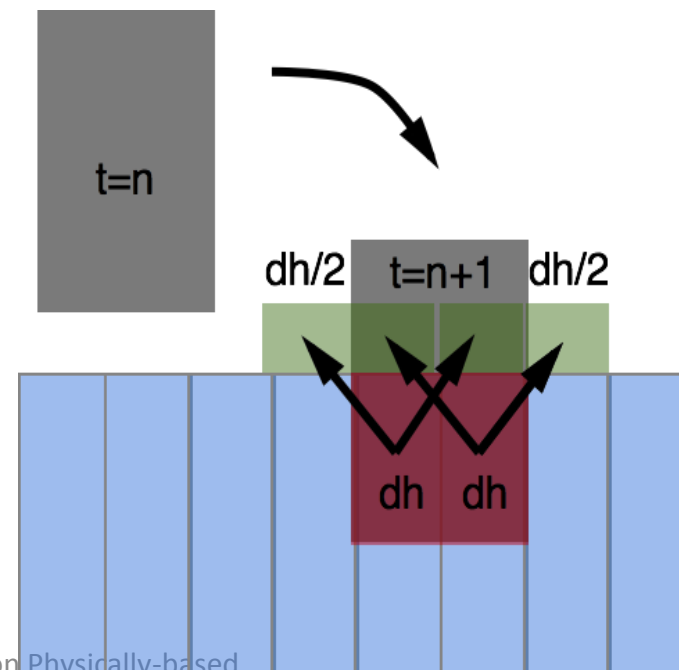
$$\frac{\partial h}{\partial t} = -h \nabla \cdot \mathbf{v}$$

$$\frac{\partial \mathbf{v}}{\partial t} = -g \cdot \nabla h$$



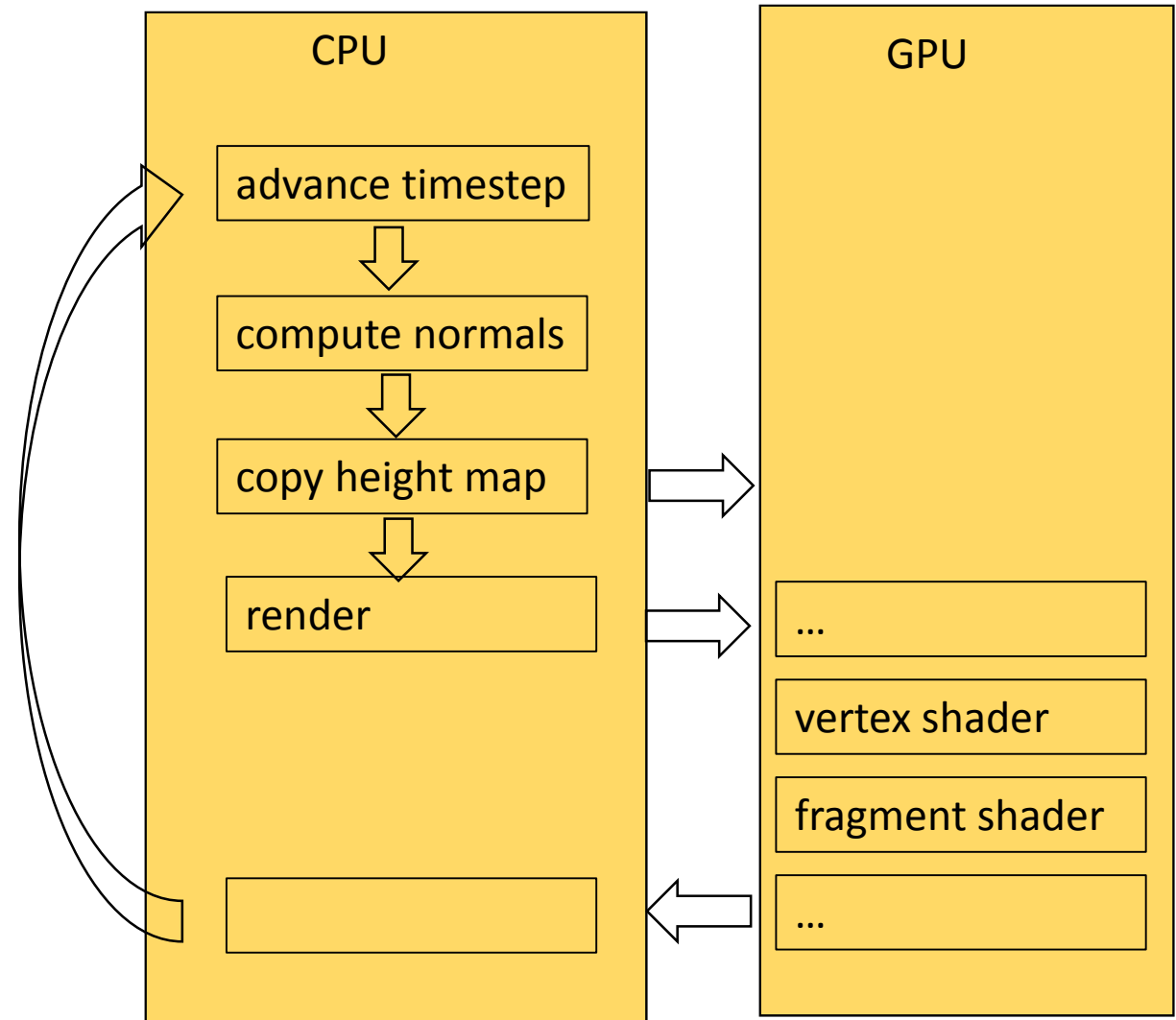
Rigid Body / Water interaction

- Assumption: Rigid body is much larger than a grid cell
- Compute changes of water displaced by the box, distribute on neighbor cells
- Compute buoyancy forces



Overview solution

- Grid size 140 x 280
- Timestep:realtime
 - get elapsed system time
 - ```
while(sim_time < elapsed){
 advance_timestep(...)
}
```
- ~ 60 frames/second



# Challenges / extensions

- Getting Interaction Rigid Body / Water stable
- Making simulation realtime
- Several Rigid Bodies including collisions
- More 'water like' shader
- Compute simulation on GPU
- ...