INFORMATION CODING
Linköping University

Realtime Particle System Simulation and Rendering in Embedded Systems

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Motivation

- Smartphones / tablets (so called embedded systems) will replace PCs in consumer households
  - Already happening
  - PCs in the future will only be used for work, and probably hardcore gaming

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- Rapid growing market for games on embedded systems
  - Considered to be one of (if not: the) most important market
  - Mainly small, casual games, but even many with advanced graphics

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- Different architecture as PCs / gaming consoles
  - Shared memory, shared bus between ALL the components
  - In comparison to PC only limited distributed memory (e.g. caches, in case of the GPU in the Nexus 10: <=256 kbytes) => need to make the most of it

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- Nexus 10 as used during this project: 8006
- NVIDIA GeForce GTX 660: 137246

=> more than 17 times faster!

Background

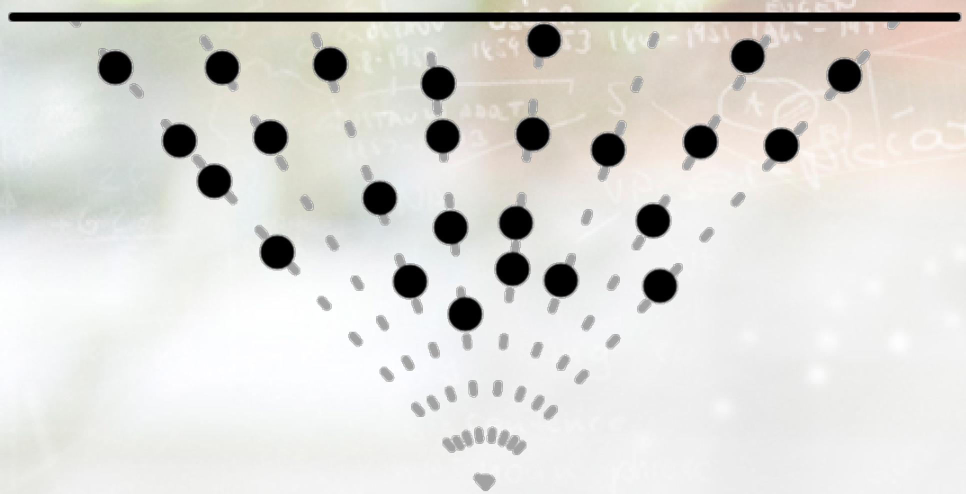
- Particle effects in computer graphics
  - Water, smoke, fire etc.
  - Navier-Stokes based solutions, e.g. “Simple and Fast Fluids”

- Current games for smartphones / tablets
  - Particle systems
  - Basically animated billboards moving in predetermined or pseudorandom way

Our contribution

- First work on effects based on simulated particle movement on embedded systems
- Based on a novel, forced-based motion model
  - No need for additional, space-consuming pressure field
  - Simulation completely done in 2D

Particle Fields



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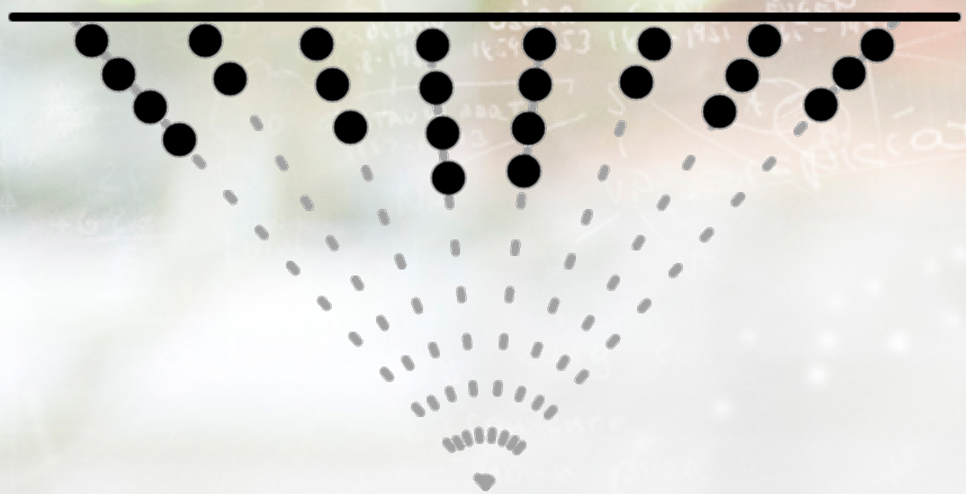
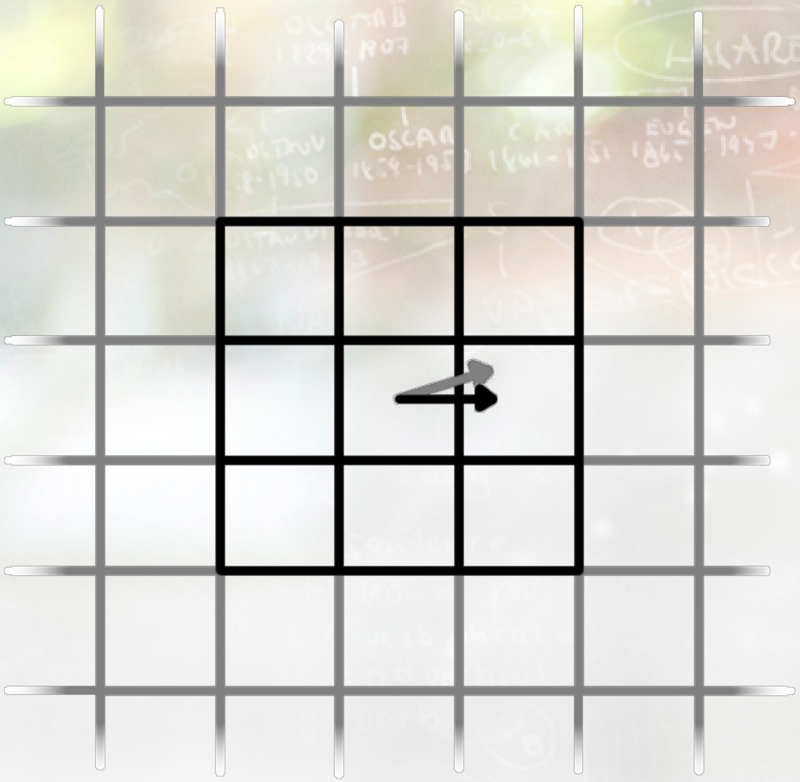
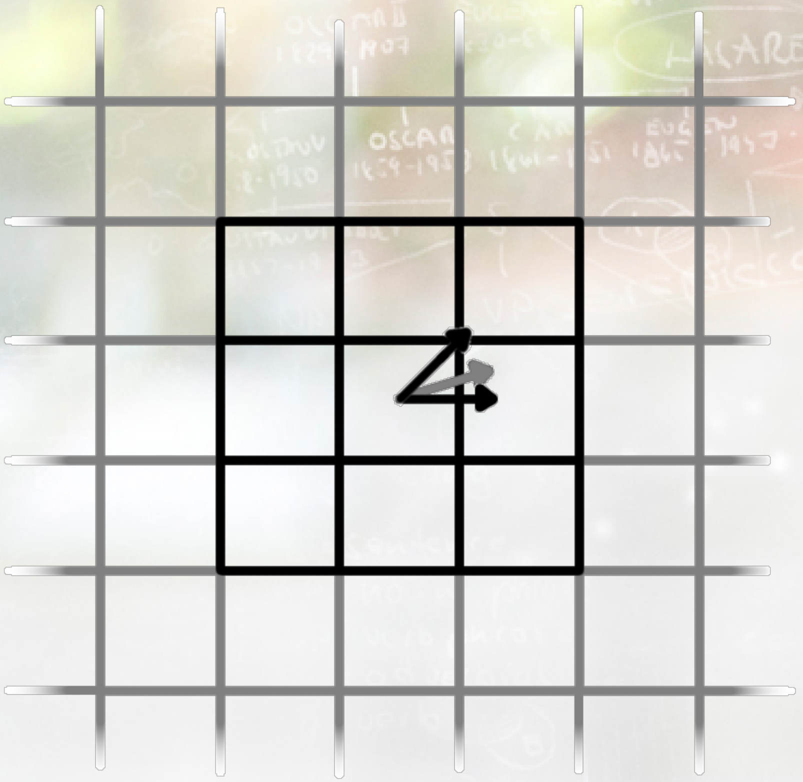


Particle Fields

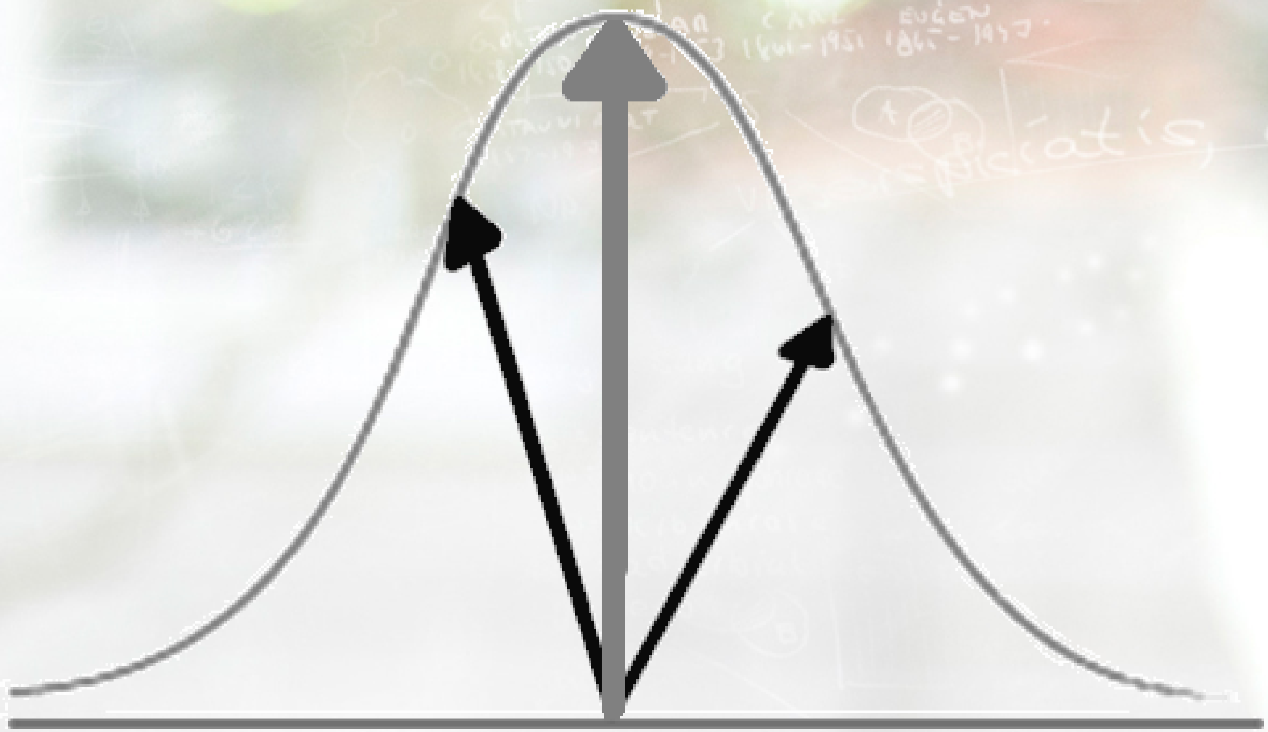
Motion Model



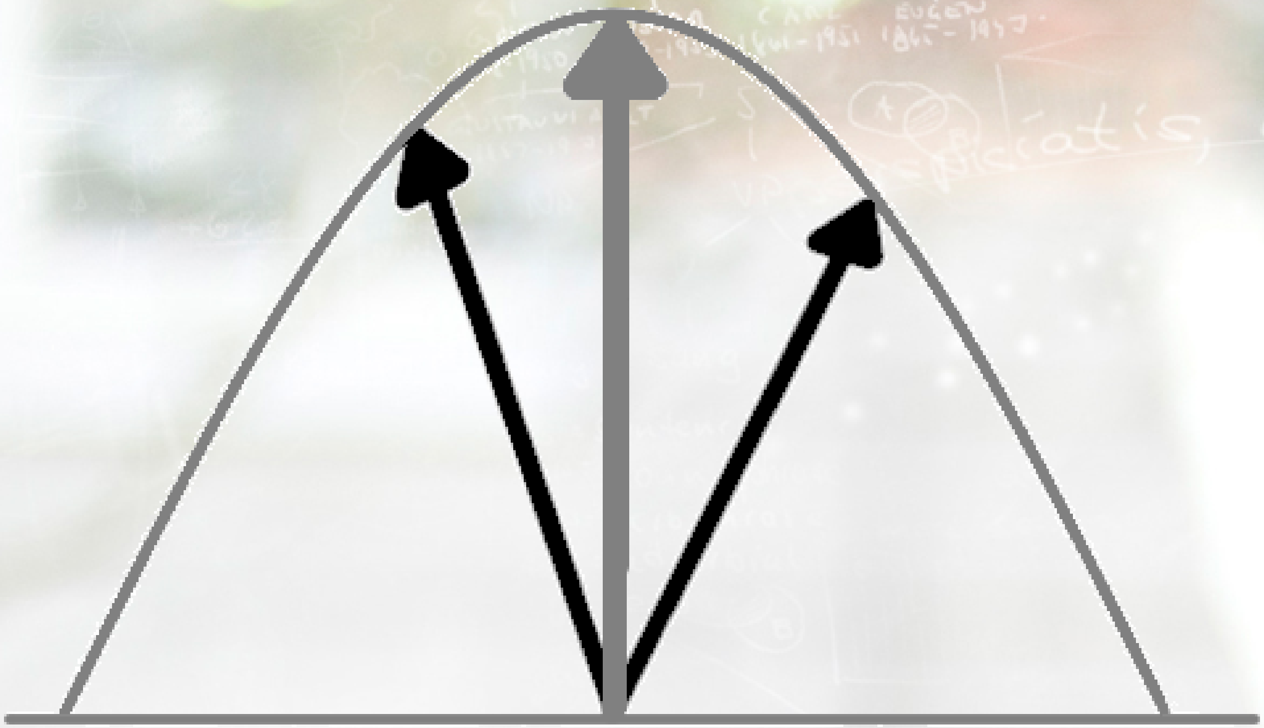
Motion Model



Motion Model



Motion Model



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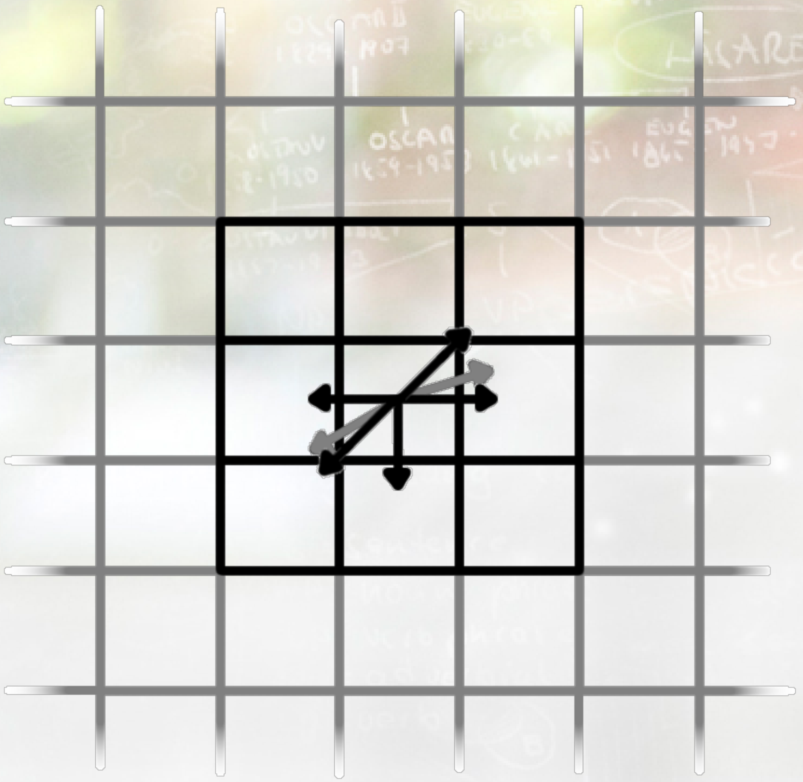

Force based motion

- 4 different forces
  - Diffusion
  - External forces (e.g. gravity)
  - Inertia
  - Random

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- Combined using different weights for each

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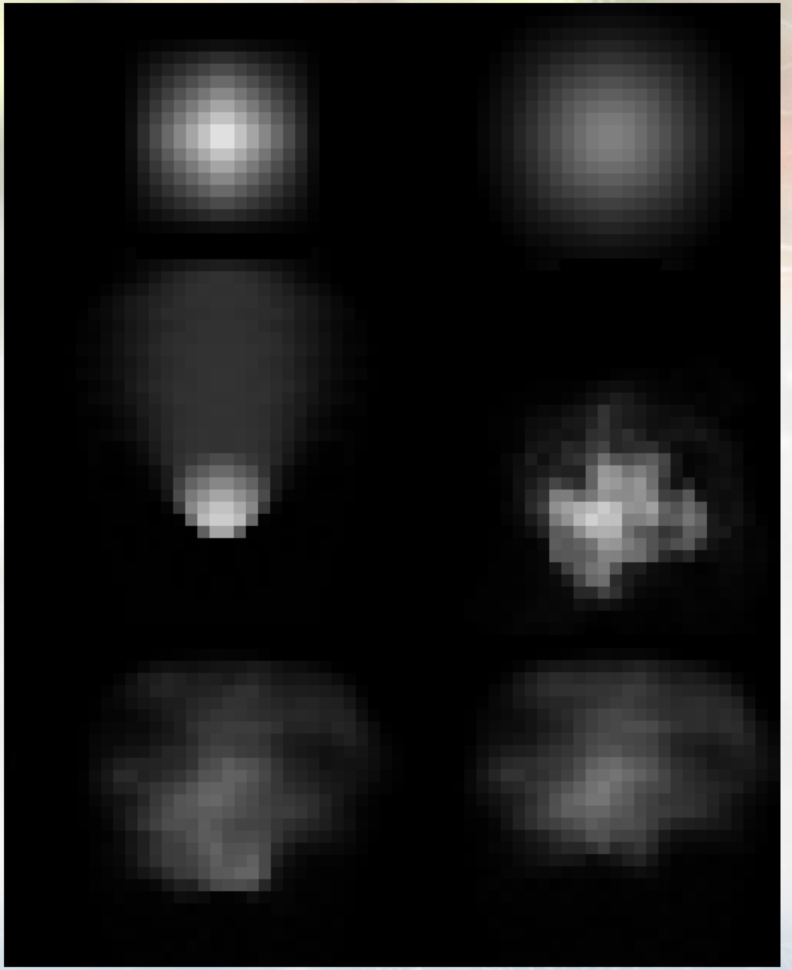

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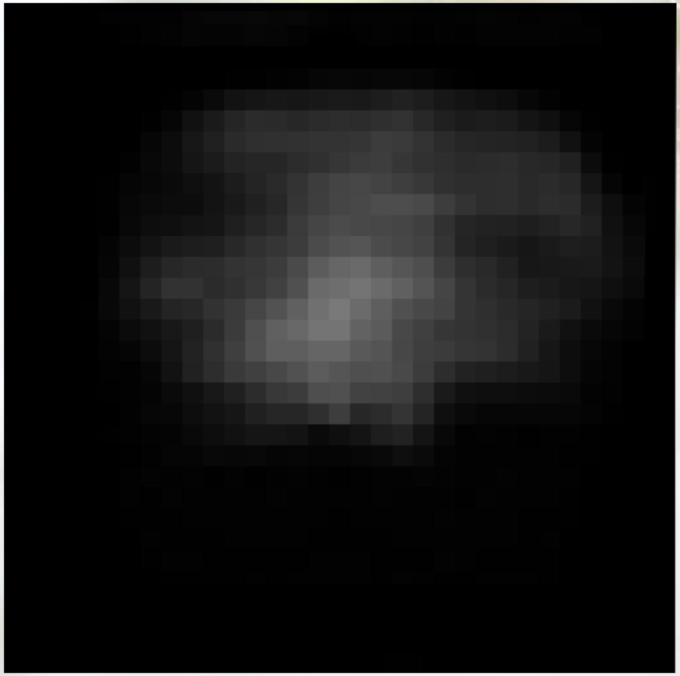

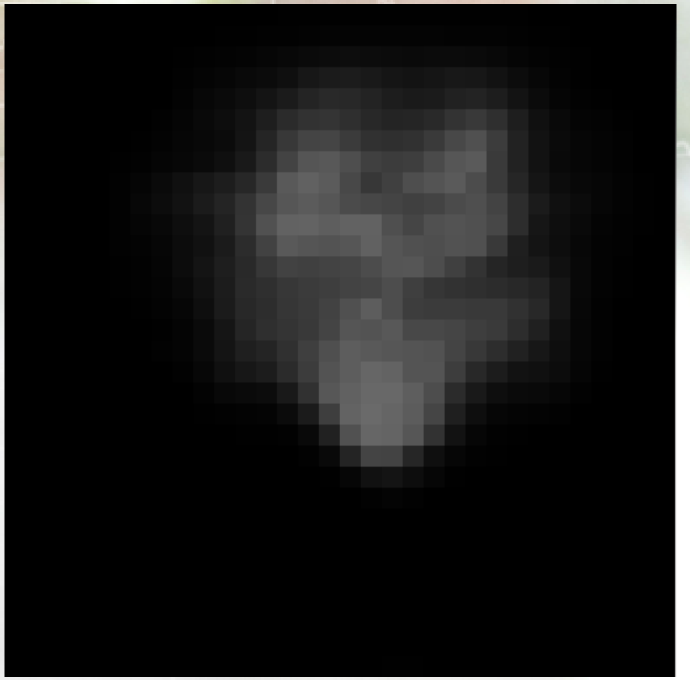

Results

	Size of particlefield	Reference (time/ms)	Simulation (time/ms)	Rendering (time/ms)	Est. FPS
Nexus 10, resolution: 2560x1600					
Fire	32x32	4.89	3.17	26.7	36.3
Water	64x64		3.59	43.2	22.3
Smoke	64x64		3.93	11.4	84.3
iPhone 5, resolution: 1136x640 **(preliminary)**					
Fire	32x32		3.4	34.2	28.2
Water	64x64		6.3	47.6	19.7
Smoke	64x64		7.6	7.2	138

Conclusion

- Effects based on simulated particle movement for games in embedded systems
- Based on novel, force-based motion model
  - Faster than fastest Navier-Stokes (by 35%)
  - Much less data (up to 80% less)
  - Easy to configure for the designer
  - Allows fast particle spreading

Conclusion

- Future work
  - Optimize the code
  - More unified approach
  - Improve visual quality