

Project Title: Particle based Cloth Simulation

1) Numerical Solvers Implemented

In this Project, a particle based cloth simulation has been animated. Two different solvers (Euler Method and Mid-Point Method) have been used to calculate the change of positions of each particle and constraints on the particles system.

- Euler Method:** This method uses the derivative information to make a linear prediction about the value at the next desired time. However, the approximations could be inaccurate as in this method each value is not predicted due to the step size. It resembles as creating a sequence of straight line segments.
- Mid-Point (improved Euler method):** This Solver provides better results as it requires working out the Taylor series approximation (one additional term). The input of the midpoint is same as that of the Euler method. Midpoint initially requires to compute the Euler step. Additionally, the derivatives are calculated again at the steps midpoint. This helps to estimate more accurate value at the next time step. It also handles the circular motion of the particle in a better manner.

2) Benchmarks

Solver / Particle size	400 Particles	900 Particles	1600 Particles
Euler Method	0.000173	0.000295	0.000504
Mid-Point Method	0.002894	0.000691	0.001116
Simulation Differences	Not much Difference, however Euler seemed little better.	Better result in Midpoint even with the wind.	Midpoint was more smooth, although took more vibration to settle.

Table 1: Computation time comparison by changing the number of particles (All time in Seconds)

By carefully examining the insights of both the solvers, the computation time taken by Midpoint method was more as compared to the Euler method justifying the fact that the derivatives are being calculated twice. Below Figures show how the cloth being simulated with spring forces holding the particles together.

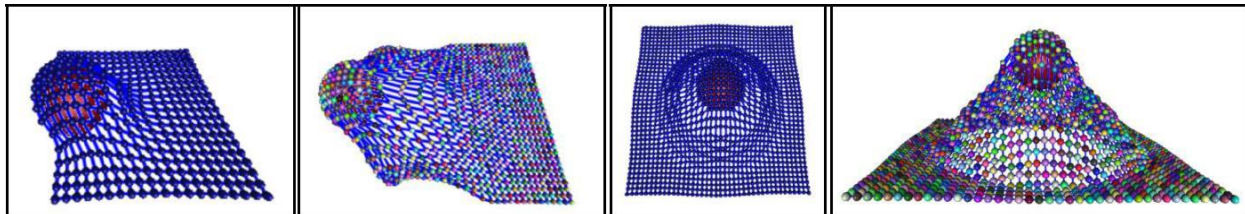


Fig 1: 400 Particles (Euler)

Fig2: 900 Particles (Euler)

Fig3: 900 particles (Midpoint)

Fig4: 1600 Particles (Midpoint)

3) Conclusion

Cloth was simulated with the numerous small particles. To attach the particles with the forces, 4 springs are used to the join every adjacent particles. (2 in X and Y directions and the other 2 in diagonals). Although much difference was not seen while examining the cloth by different solvers, Midpoint Method animated the cloth in a better manner due to much accurate approximations and also became stable at a faster rate than the Euler method.