Authors

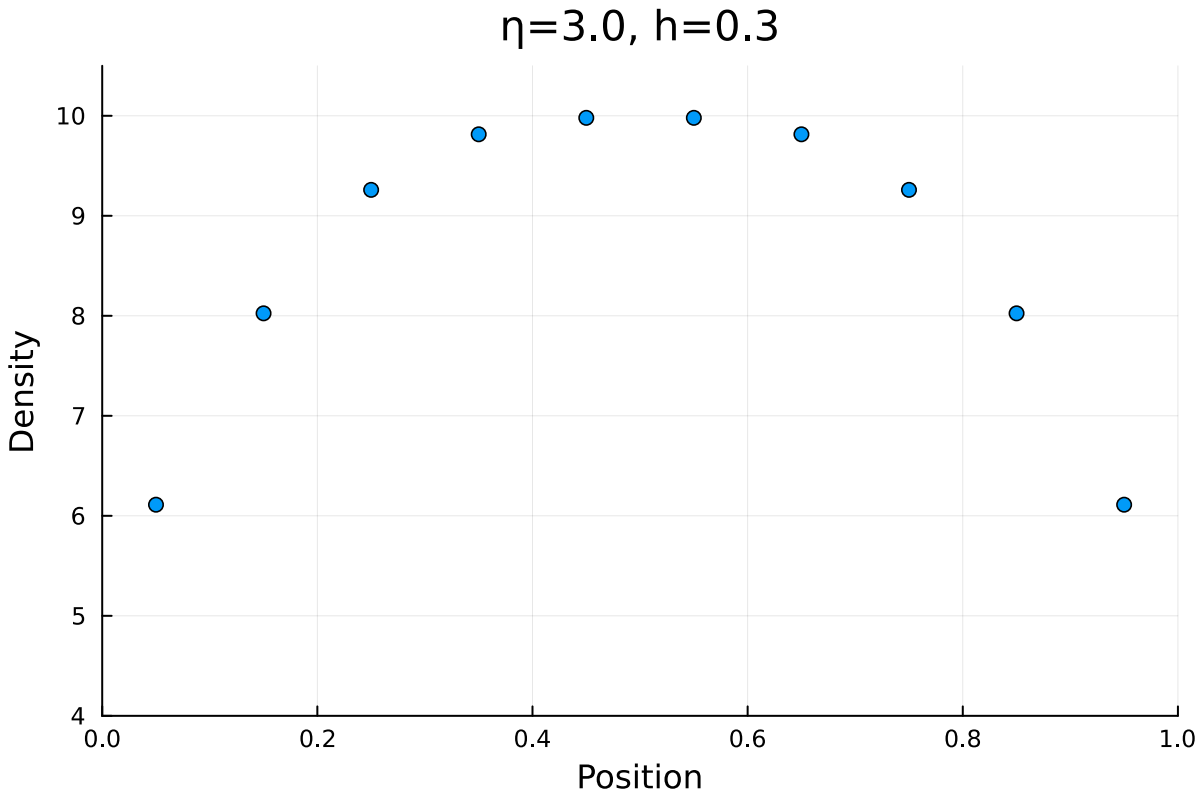
Author	Matrikelnummer
Paul Römer	7377945
Philip Julius Pupkes	7360318
Alice Coors	7392745
Muhammad Fakhar	7432447


```
plot_density (generic function with 1 method)
```

```
function plot_density(η)
    data = DataFrame(CSV.File("results/results_10_$η.csv"))
    snapshot = filter(row -> row.time_step == 0, data)
    h = round(snapshot.h[1]; digits=3)
    snapshot, scatter(snapshot.position, snapshot.density, xlabel="Position",
    ylabel="Density", title="η=$η, h=$h", legend=false, xlims=(0, 1), ylims=(4,
    10.5))
end
```

1. Results for η=3

```
snapshot, p = plot_density(3.0);
```




```
p
```

[6.11111, 8.02469, 9.25926, 9.81481, 9.97942, 9.97942, 9.81481, 9.25926, 8.02469, 6.11111

```
snapshot.density
```

[0.05, 0.15, 0.25, 0.35, 0.45, 0.55, 0.65, 0.75, 0.85, 0.95]

```
snapshot.position
```

h = 0.3

```
h = round(snapshot.h[1], digits=3)
```

Neighborhood matrix N_ij

neighbors (generic function with 1 method)

```
neighbors(i) = abs.(snapshot.position .- snapshot.position[i]) .<= 2h
```

N = 10×10 BitMatrix:

```
 1  1  1  1  1  1  1  0  0  0
 1  1  1  1  1  1  1  1  0  0
 1  1  1  1  1  1  1  1  1  0
 1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1
 1  1  1  1  1  1  1  1  1  1
 0  1  1  1  1  1  1  1  1  1
 0  0  1  1  1  1  1  1  1  1
 0  0  0  1  1  1  1  1  1  1
```

```
N = hcat(collect(neighbors(i) for i in 1:10)...)
```

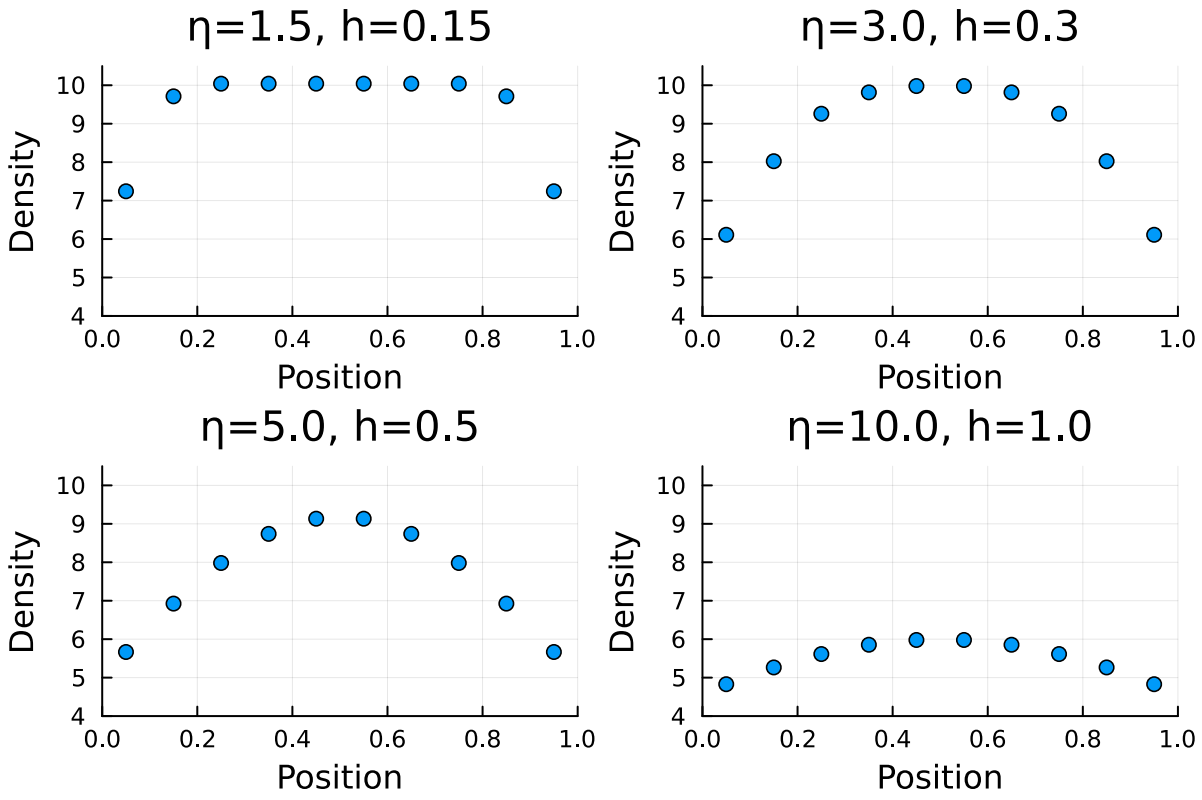
2. Density at the Edges

The density of particles should be equal to the number of particles used. Why is this not the case for the particles near x = 0 and x = 1?

As the density calculated by smoothing over a certain distance, near the edges (0 and 1) the density is averaged over the neighbouring particles and the empty space outside of the domain. This explains the reduction in the density. Near the center the density is smoothed only over neighbouring particles resulting in the expected density of $\rho \approx N$.

3. Effects of Varying η

Varying η directly influences the smoothing length h. It follows that for an increasing η, the density of particles towards the edges will reduce as more empty space is included in the smoothing radius. This effect affects all particles that are $r \leq 2h$ from he edges. (Or, effectivly, neighbors of an imaginary particle at $x = 0$ or $x = 1$)




```
plot(
    plot_density(1.5)[2],
    plot_density(3.0)[2],
    plot_density(5.0)[2],
    plot_density(10.0)[2],
)
```