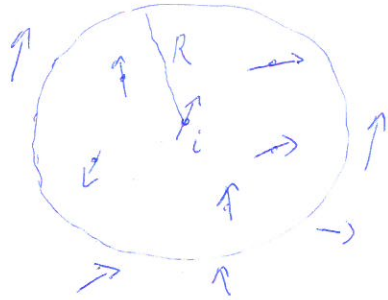
VICSEK MODEL

2d model of agents that interact only through a bias on their direction (not excluded volume interactions)

$$\begin{cases} \vec{r}^{(i)}_{t+\Delta t} = \vec{r}^{(i)}_t + v\,\hat{u}^{(i)}_t \Delta t \\ \vartheta^{(i)}_{t+\Delta t} = \langle \vartheta^{(j)}_t \rangle_{|r_i - r_j| < R} + \sqrt{2 D_{rot} \Delta t}\;\eta_t \end{cases}$$

noise from a Gaussian with zero mean and variance 1

rotational diffusion coefficient



$\langle \vartheta^{(j)}_t \rangle_{|r_i - r_j| < R}$ is the average direction of the particles within a radius R from particle i

Use periodic boundary conditions (PBC)

Parameters

ρ = density of particles = $\frac{N}{V}$ ← volume of the box

D_{rot} = set the intensity of the noise

$\frac{v \Delta t}{R}$ = importance of the self propulsion with respect to R

Study:
- phase transition (eventually critical exponents) for different slices in the parameter space
- Use the order parameter $v_a = \frac{1}{Nv} \left| \sum_{i=1}^{N} \vec{v}^{(i)} \right|$
- Nice movies? - typical size and duration of flocks?

Possible extensions:
- from 2d to 3d
- reflecting boundaries instead of PBC
- "absorbing" boundaries
- implementation of "angular vision" (use only particles in the circular slice to compute $\langle \vartheta^{j} \rangle$)