ENAS 991: Assignment 1
(Writeup)

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(A) When the noise strength is increased at fixed packing fraction in the Vicsek model, the average MSD of the cells, within the same time window, decreases. And from the polarization plots, it is evident that the time-averaged polarization decreases with increasing noise. This suggests that the order in the system decreases with increasing noise; there is lesser polarization, more random motion, and consequently, more congestion resulting in lesser “migration” (MSD).

When packing fraction is increased at constant noise, time-averaged polarization increases as well. However, beyond a level of noise, where the curves crossover, the reverse phenomenon is observed; higher packing fraction is associated with lower polarization. At lower values of noise, lower packing fraction means lesser interaction between the particles and the scope for alignment is lesser. As the packing fraction increases, (higher density) they align better and show collective behavior.

(B) Clearly, the distinctive aspects on either side of the spectrum in epithelial-to-mesenchymal transition are directed and ordered cells on one side, as opposed to more entropic and less collective behavior on the other. Accordingly, as highlighted in (A), the Vicsek model also describes two competing phenomena: repulsive forces between the cells and the alignment of velocities. Further, by controlling the parameters such as noise strength, packing fraction, etc. in the Vicsek model, one can devise experiments to effect required changes to the end of attempting an explanation for such transition from one kind of behavior to the other: from an ordered, collective state to a more individualistic motion.