Questions about theory and simulation

1. Why do you set a correlation time τ before simulation, then use the simulation results to calculate τ again? Do you expect them to be different?

τ, the time scale of active noise, lies in the heart of the theory and simulation. The following velocity updating rule in your simulation,

> $$u_{i_n} = u_{i_{n-1}} - \nu_i u_{i_{n-1}} + \nu_i \sqrt{B_i dt} N_{ni}, \quad i = x, y, z.$$

has to be designed in such a way, that velocity u is exponentially correlated, $\langle u(t)u(t')\rangle \propto e^{-|t-t'|/\tau}$ (although I don't know how this updating rule enforces this correlation).

Simulation returns $xyzt$ data, you use them to calculate the correlation time again:

> saturation part of the MSD,ie, $\lim_{t\to\infty}\langle\Delta x(t)^2\rangle + \langle\Delta y(t)^2\rangle$. To compare we use τ and $r = r_o - r_i$ to make dimensionless the quantities from the experiments and also compute τ for each simulation to make $\hat{t}$ dimensionless. And

Would you expect them to be different? (The only thing that can make τ different is the reflection boundary condition, and only very frequent occurance can make the difference significant enough to be noticed, IMO)

2. Theoretically, would you expect τ to be a property of a bacterial suspension and independent of how you measure it?

We've been trying to measure τ in different ways, e.g. with 2-μm particles and with oil droplets as tracers. At higher concentration, we can also measure the flow persistence by PIV to get a τ. Are these τ's expected to be the same (theoretically)?

Looking at the assumptions made in the simulation, any object immersed in an active bath exhibits a noisy motion with exponentially correlated velocity. Hence, I would infer that at least the tau measured from 2-μm particles should apply to oil droplets. Do you think this is a way to test the assumption?

3. A similar question as Q#1, there are two quantities very similar to each other, Π_3 and d_{st}. The former is an input to the simulation and the latter is the result. How are they different?

> $$\Pi_3 = \Pi_1\Pi_2 = \frac{v\tau}{r}, \quad \text{Bacteria versus confinement,} \qquad (1.23)$$

$$d_{st} = \frac{v_{tc}\tau}{r}, \tag{1.24}$$

Again the only thing that can distinct the two is the boundary condition.