Simulation notes 6

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1 The plots

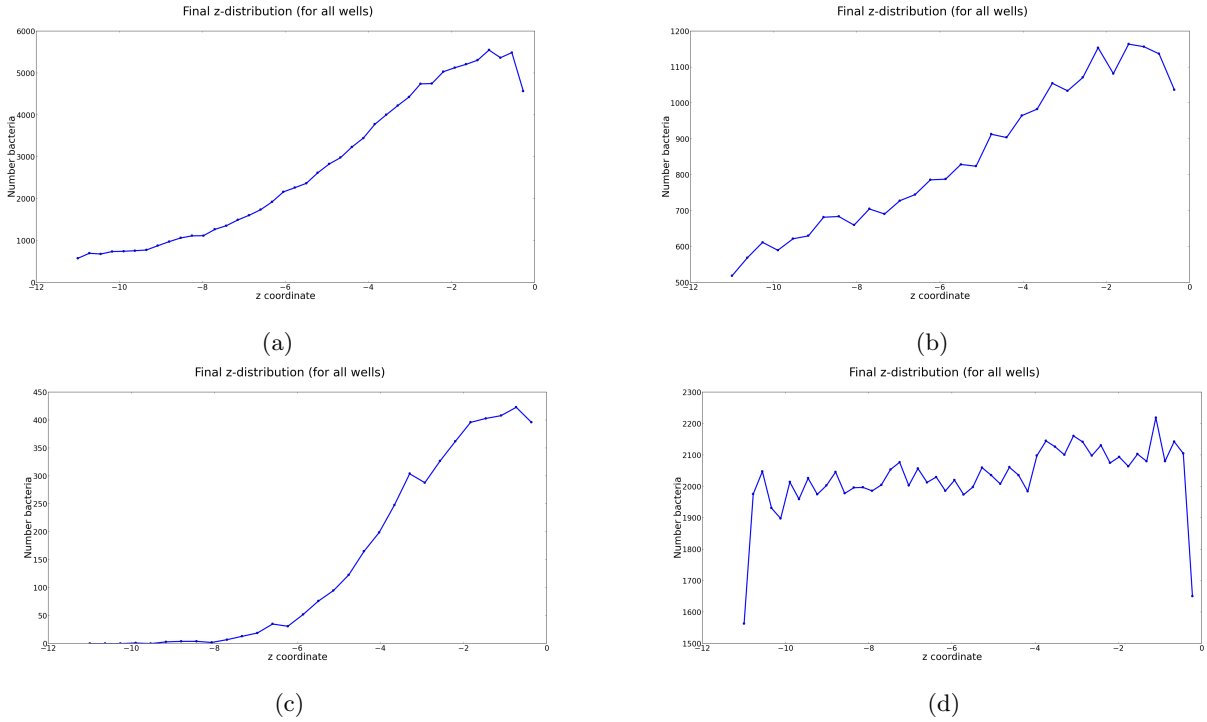


Figure 1: (Sorry, ignore the titles on these graphs). Distribution of z-coords (z=0 mm is top of well, z=-11.5 is bottom) of bacteria from (a) all 24 wells after 15 hours; (b) only bacteria in the first 2 wells after 15 hours; (c) bacteria in the final 3 wells after 15 hours and (d) bacteria from all 24 wells after 4*24 hours. We see that since the channels are located at the top of the wells, larger bacterial densities are found here. Diffusion through such a large well takes some time: even after 4 days (d), a slight gradient in density is still observable. One thing then to keep in mind: if you wanted to increase the wave speed by playing with the channel dimensions, the most important property to vary would be the width of the channels. Past some depth, deeper channels will not affect the speed of the travelling wave).

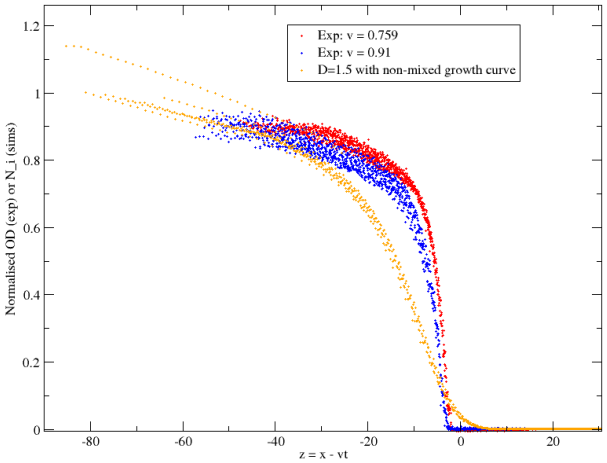
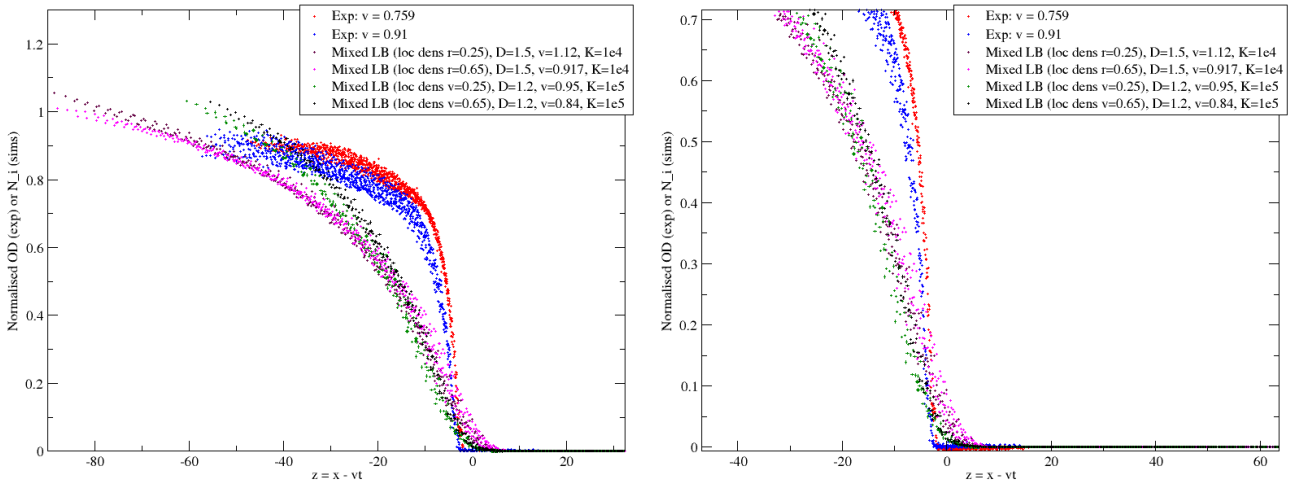


Figure 2: Bartek gave me the growth-curve data for the non-mixed wells (with agarose) which we thought would be better than the well-mixed LB data. Plotting the shape of the wave (speed about 0.76 well/h) we see that there is still a discrepency between the experiments (blue and red) and simulation (orange). The simulation wave is much shallower, and the tail is noticeably different too.



(a) (b)

Figure 3: These are the waveforms when calculating growth rate from a local density. Rosalind had the idea that we could try and use the local density for determining the growth rate. Our growth function is $g(N/K)$ and I was using the value of N/K from the entire well. In these plots I define a small cube of volume v and convert the density of bacteria in this to the appropriate N/K value. The waves in the simulation are still shallower than the experimental waves. I expected that since bacteria tend to be at the top of the wells, growth would be slower in the case with local densities, hence the waveform should be shallower than before. Plot both these on the same graph. One nice observation is that the local density method seems to get rid of the weird kink we observe with the well-mixed $g(N/K)$, but the waveforms are still noticeably different from the experimental ones. I was surprised how different the plots are for carying capacity $K = 10^4$ and 10^5, though this difference is probably only due to the diffusion constant being different. I'm also suspicious as to why the speeds are so high for these simulations – this could just be chance, but I haven't checked yet. These simulations take a very long time – it would not be feasible to increase to $K = 10^6$.