

1 S1 Text - Implementation of chemotaxis

The average run time τ_{run} is modulated by a chemical gradient for chemotaxis. For a chemoattractant, we use the following simple implementation of that modulation (other functional dependencies can also be used [29,30]):

$$\tau_{\text{run}} = \begin{cases} \tau_0 & \text{for } \nabla C_{\parallel} \leq 0 \\ \tau_0 \left(1 + \frac{\nabla C_{\parallel}}{\nabla C_0}\right) & \text{for } 0 < \nabla C_{\parallel} \leq \nabla C_0 \\ 2\tau_0 & \text{for } \nabla C_{\parallel} > \nabla C_0 \end{cases} \quad (1)$$

where τ_0 indicates the mean run time in absence of gradients, ∇C_{\parallel} indicates the projection of the chemical gradient onto the direction of motion and ∇C_0 is a threshold gradient for which the maximal run time is reached. For a chemorepellent, a corresponding expression is used, modified such that runs down the gradient are prolonged,

$$\tau_{\text{run}} = \begin{cases} \tau_0 & \text{for } \nabla C_{\parallel} \geq 0 \\ \tau_0 \left(1 - \frac{\nabla C_{\parallel}}{\nabla C_0}\right) & \text{for } -\nabla C_0 < \nabla C_{\parallel} \leq 0 \\ 2\tau_0 & \text{for } \nabla C_{\parallel} \leq -\nabla C_0. \end{cases} \quad (2)$$

Finally, if the bacterium is attracted to a preferred concentration C^* , then Eq. (1) is used for $C < C^*$ and Eq. (2) for $C \geq C^*$. We note that, via this condition, the run times depend not only on the concentration gradient, but also on the concentration itself.