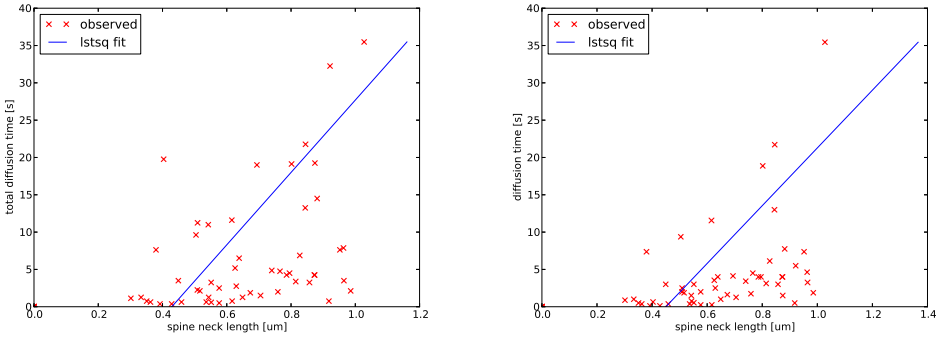
0.1 Validity of the model

As we saw in the introduction to the analysis chapter it is possible to introduce enough walkers so that there is no mathematical difference between the combined model and the PDE-model. For all practical purposes, however we will not use that many walkers, because it is not the reason we introduced them in the first place. The simulations done in the analysis-chapter are largely done for verification purposes (see chapter **??** in the appendix). In other words, our model converges to the continuum model in the limit of sufficient walkers.

0.2 Diffusion times into spines

Craske et.al. suggest that the neck of spines act as diffusion barriers which slow down, but don't completely stop the diffusion of PKCγ into spines. The function of this barrier is a bit unclear, but the presence of it is undisputed. In their measurements they found a delay of around $5 - 10$ seconds from elevated concentration levels in the dendrite until a similarly elevated concentration level occurred in spines with necks longer than 0.5μm. Using parameter values which resemble the values found in actual (rodent) neurons and neurites in the developed software, the observed delay-times have been recreated. Figure 1 shows plots of the observed diffusion times into spines. This figure shows a clear trend for longer diffusion times as the neck length of the spine increases. Figure **??** further support this claim and implies the average diffusion time for PKCγ into long necked spines to be of accordance to the results from Craske et.al. Seeing as there are no additional complexities added to the random walk model we can assume that the spine neck does in fact function as a diffusion barrier.



(a) (b)

Figure 1: This is a meaningless caption.

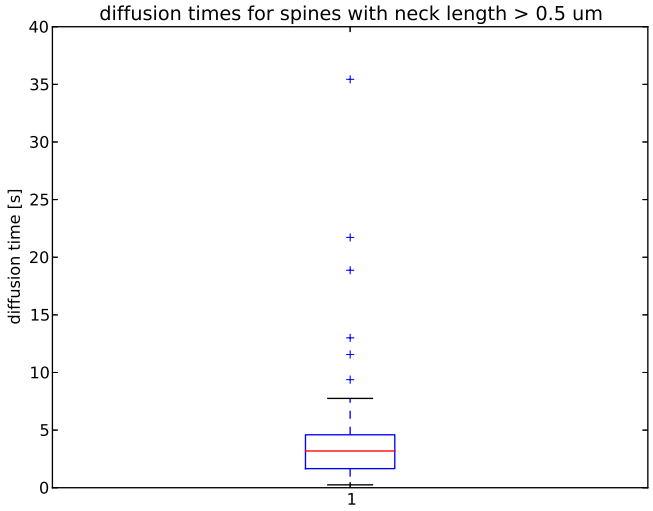


Figure 2: Boxplot of the relative diffusion times (time between elevated concentration in dendrite and elevated concentration in spine head) into spines with necks longer than 0.5μm. Similar studies were done by Crase et.al. and found diffusion time (unclear whether relative or not) to be somewhere around 5-10 seconds.

Through the simulations it became apparent that there must be some sort of limiting factor which limits the number of PKCγ particles that are let into the spine. In real life this is achieved by a concentration gradient which tends to zero (or negative values) meaning that no particles will diffuse into the

spine after it is "filled" up. A random walker will not feel this concentration gradient unless it is explicitly told so. The alternative solution then, is to reduce the probability for particles to diffuse into a spine for each particle that get caught in the spine head by some reasonable factor.