

# Discrepancies between the diffusion coefficient calculated based on the area and on the displacement squared

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Horizontal and vertical artificial eye traces have been generated ( $N=1000$ , 300 samples per trace) (relevant codes: `EMBrownian.m`, `Calculate2DArea.m` and `CompareRandomWalks.m`) following a pure or a biased random walk with a given diffusion coefficient. The bias was specified in terms of angle, amplitude (per second) and dispersion of the samples around the amplitude and angle of the bias. The distribution of the artificial eye positions thus generated are shown in the first two panels of the following graphs.

Note that a pure random walk is always characterized by a circular distribution, while the distribution yielded by a biased random walk is characterized by deviations from circularity. The third panel in the graphs shows a comparison between the diffusion coefficient calculated on the basis of the displacement squared and on the basis of the area both for the biased and for the pure random walk distributions.

The diffusion coefficient was calculated based on three methods (displacement squared, area, PCA). Note that the diffusion coefficient based on the PCA yields always a value close to the original diffusion coefficient for the biased random walk. On the other hand, the diffusion coefficient based on the displacement square increases with the bias, and the diffusion coefficient based on the Area, when the dispersion around the bias is very small, underestimates the actual diffusion coefficient. Note also that diffusion coefficient based on area, PCA and displacement square are all equivalent in the presence of a pure random walk.

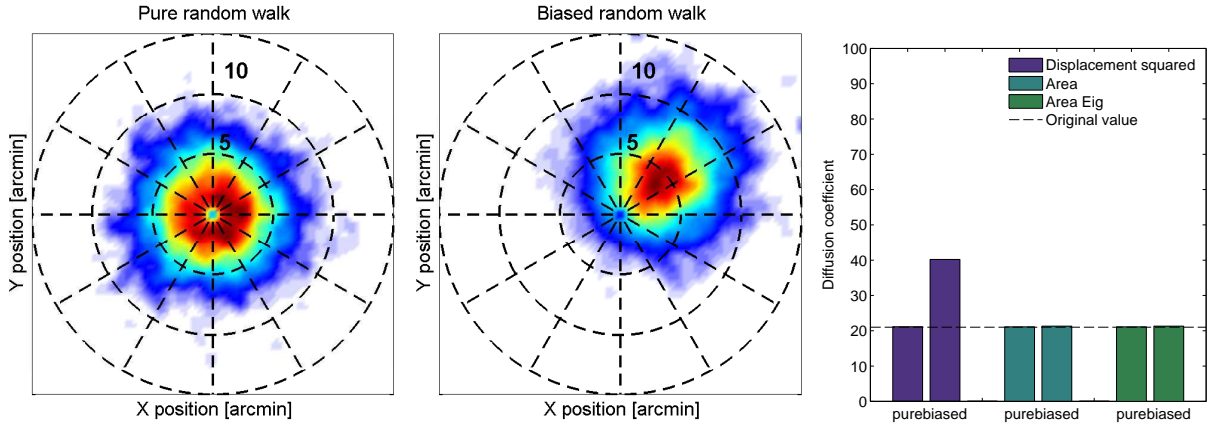


Figure 1: Bias:  $45^\circ$  angle, 20 arcmin amplitude, 3 dispersion

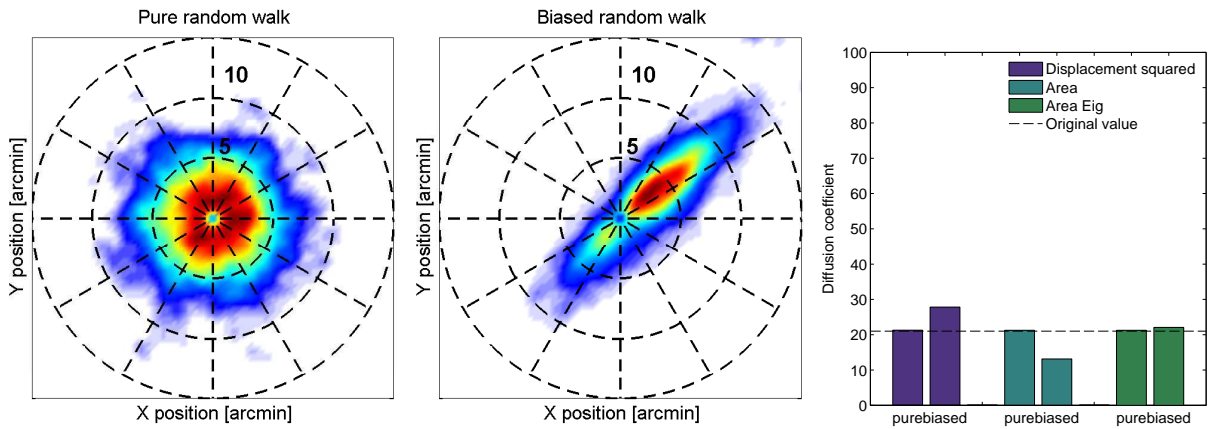


Figure 2: Bias:  $25^\circ$  angle, 10 arcmin amplitude, 0.2 dispersion

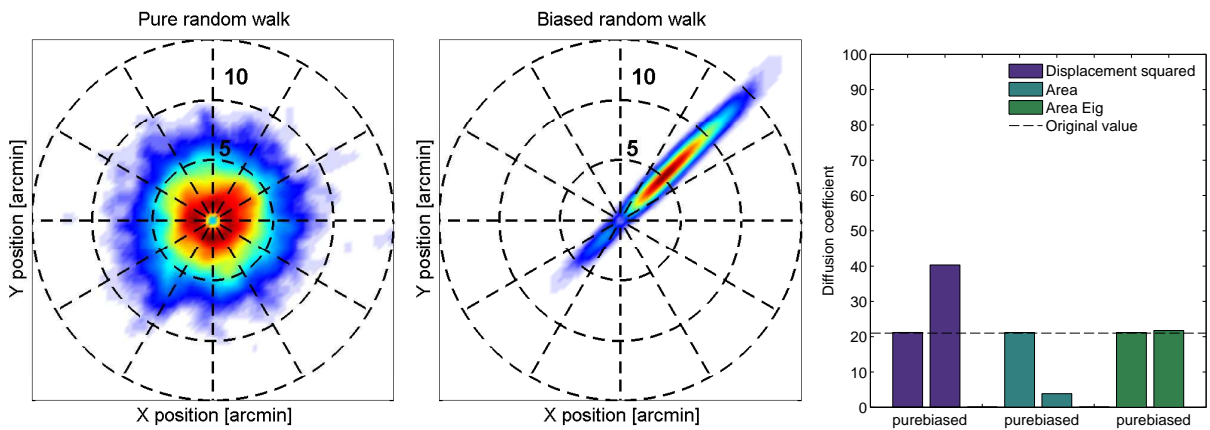
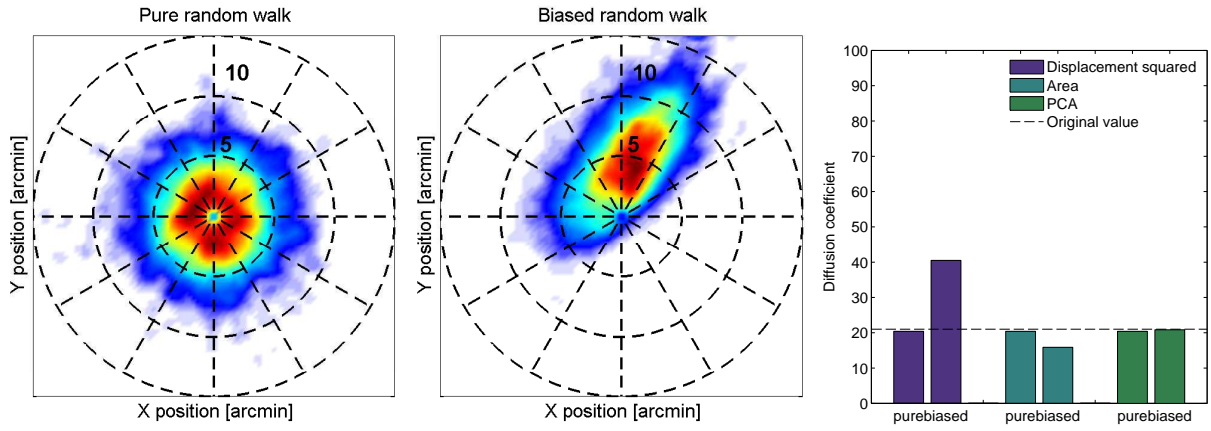


Figure 3: Bias:  $45^\circ$  angle, 20 arcmin amplitude, 0.1 dispersion



**Figure 4:** Bias:  $90^\circ$  angle, 20 arcmin amplitude, 1 dispersion