Supplementary Information

Swimming of bacterium *Bacillus subtilis* with multiple bundles of flagella

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Supp. Video A movie showing the transition from a double bundle to a single one. The indicated bacterium by the arrow swims with a double bundle, tumbles around 0.6 second, and then starts a new run with a single bundle.

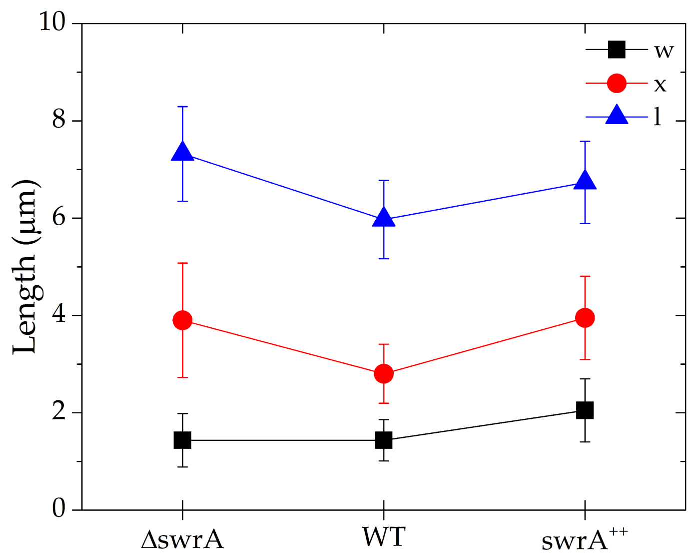

Fig. S1 Characteristic length scales of the bundle. Length, width, and length of the overlapped area by the bundles are indicated by l, w, and x, respectively. Bundle length is almost as long as the body length. The bundle is very loose, and its width is roughly twice the body thickness. The overlapped area by the bundles only covers half of the body surface.

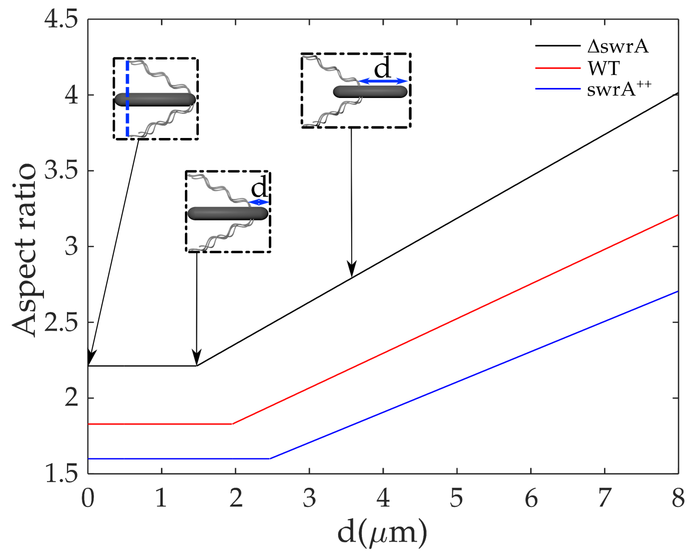

Fig. S2 Effective aspect ratio of the cells including bundles as a function of the bundle position on the cell body. The indicated cell body is its average position when the cell wobbles. The distance of the bundle from the cell head with respect to the swimming direction is indicated by d. The broken point in each line is where the distal end of the bundle reaches to the rear of cell as demonstrated. The horizontal and sloped lines are the equations $L/(2l\sin\beta/2)$ and $(d+l\cos\beta/2)/(2l\sin\beta/2)$ where L, l, and β respectively represent cell length, bundle length, and opening angle. The conditions $d+l\cos\beta/2<L$ and $d+l\cos\beta/2\geq L$ are respectively satisfied in the regions of horizontal and sloped lines. The average cell and bundle length with different opening angles have been used to plot the lines. Strains with a fewer flagella can have a larger aspect ratio if the distance between the bundles on the body in various strains differs less than $\sim$1 μm.

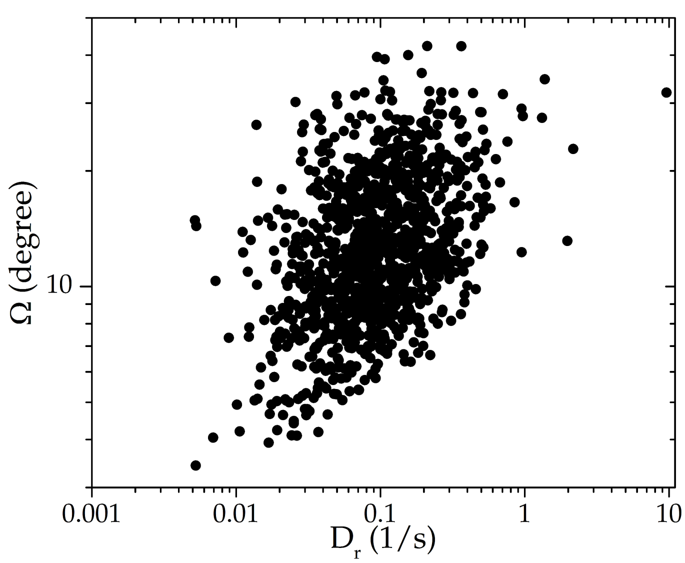

Fig. S3 Correlation of the wobbling angle and rotational diffusion coefficient. Representative data is for WT strain in the double logarithmic scale for the clarity. Pearson's correlation coefficient for the strains ΔswrA, WT, and swrA^{++} are r=0.15, 0.22, and 0.31, respectively.

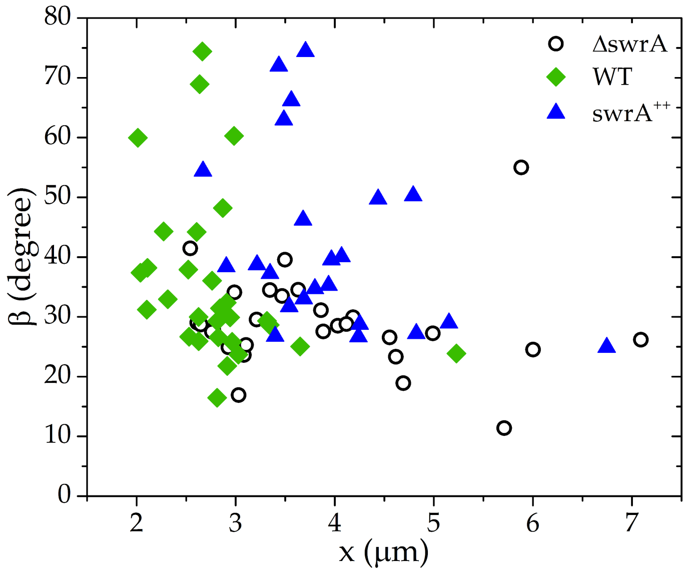

Fig. S4 Anti-correlation of the length of overlapped area by the bundles with the projected angle between the bundles. Pearson's correlation coefficient for the strains ΔswrA, WT, and swrA^{++} are $r = -0.09$, -0.32, and -0.39, respectively.