Supplementary Material (ESI) for Integrative Biology

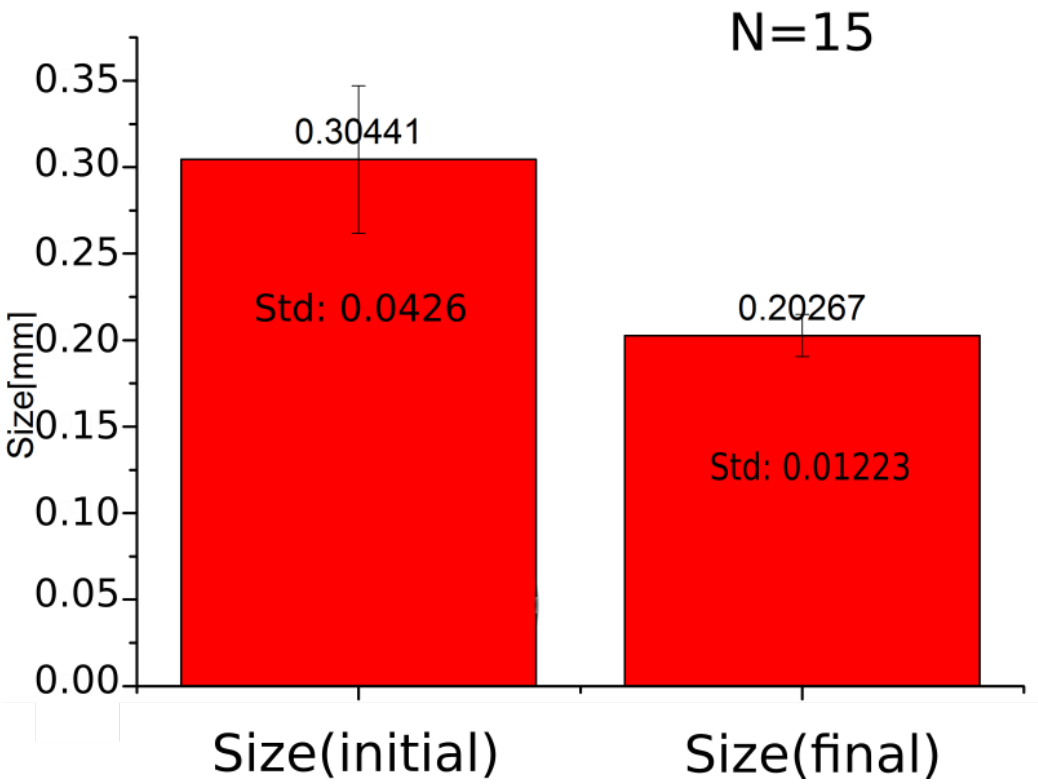


Figure 1: Comparison of the diameter of the hydra spheroids after the first deflation (left) compared to the minimum diameter of the hydra spheroid before the axis appears (right). The standard deviation is lower on the right, indicating that different sized spheroids tend to adjust to the same diameter N=15 spheroids.

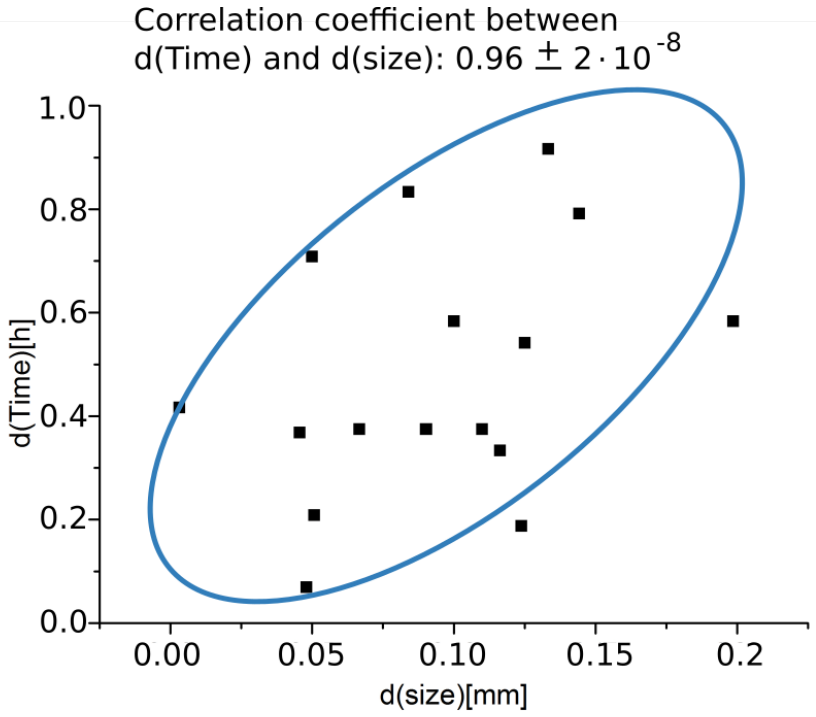


Figure 2: The time required for spheroid size change (cf. Fig. SI 1) correlates with the amount of size change (Spearman correlation coefficient $0.96 \pm 2 * 10^{-}8$).

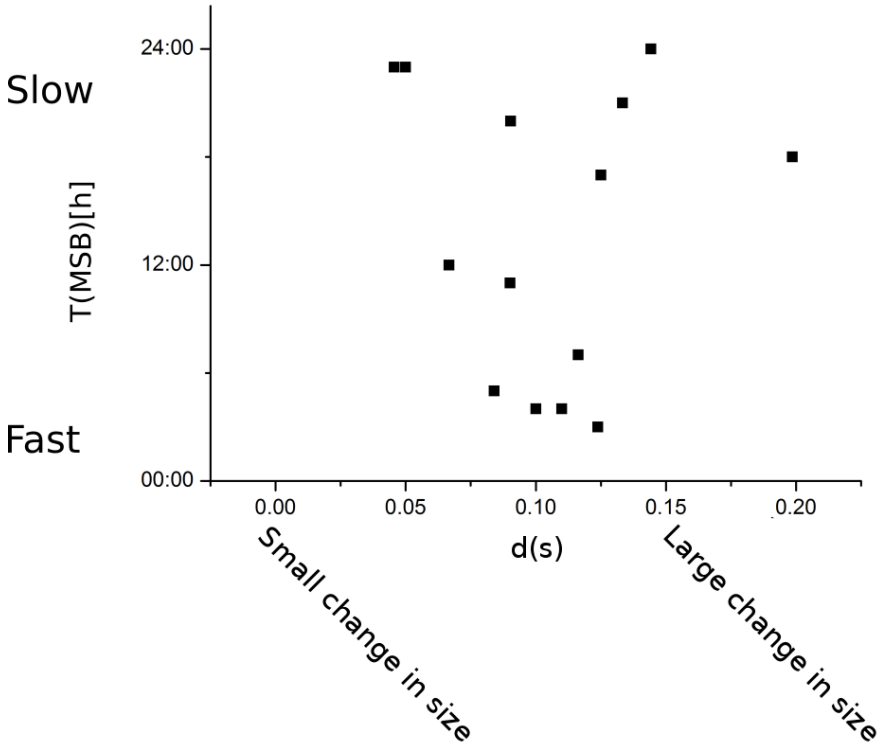


Figure 3: The time span from hydra spheroid size reduction until axis establishment, T(MSB)) (MSB: mechanical symmetry breaking), as a function of the size change (d(s)) of the hydra spheroid. Both parameters do not correlate (Spearman correlation coefficient -0.01, significance 0.97.)

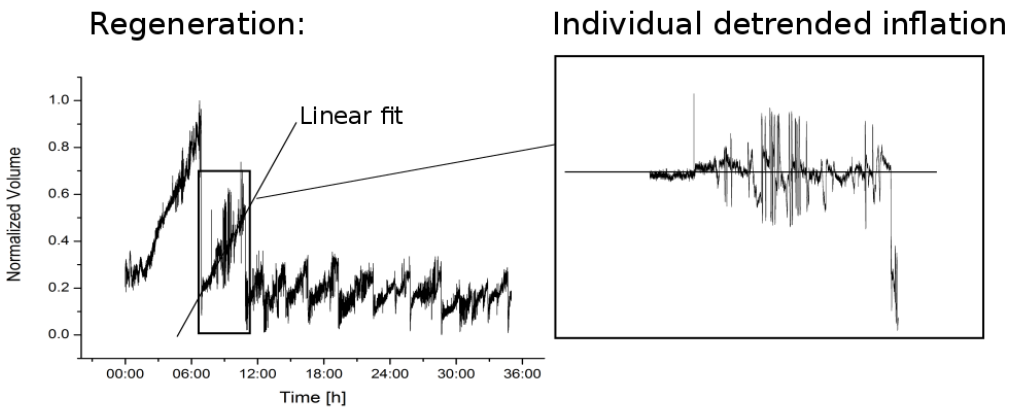


Figure 4: Spectral analysis and cross correlation. A linear fit on every individual inflation is subtracted from the data to obtain a detrended signal. The spectral analysis is performed on the detrended signal (for each inflation).

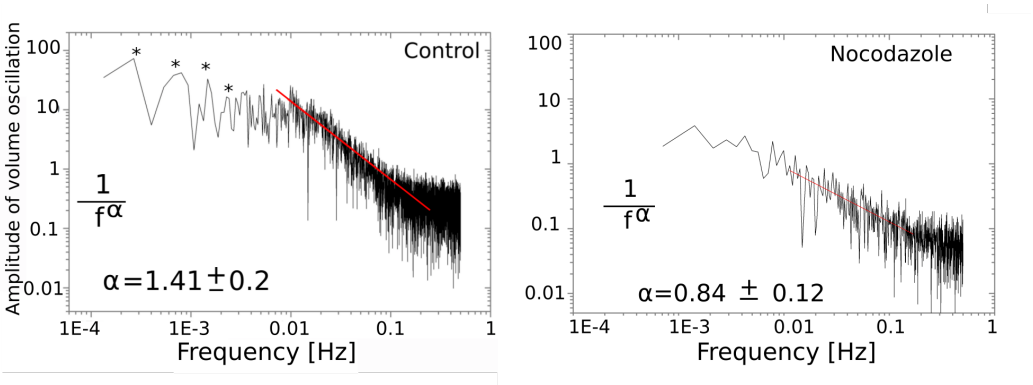


Figure 5: For Fourier transform, each sawtooth of the volume oscillations of the spheroids was detrended by subtraction of the linear fit (Supplementary Information figure S4). The analysis of the detrended oscillations revealed $1/f$ scaling behaviour of the frequency spectrum, $1/f^{\alpha}$, where $\alpha = 1.43 \pm 0.21$ ($n = 8$) for the controls, above frequencies of $0.01Hz$. The control spectrum showed individually distinguishable peaks at the lower frequencies (marked with asterisks). Multiplying this frequency by the duration of the observed periods of inflation revealed the number of sinusoids during each inflation. Each inflation included one sinusoid oscillation that was superimposed by 2, 3, 4 and 6 higher harmonics. This means that each inflation followed a regular pattern of superimposed sinusoids that scaled with the absolute duration of the inflation (and was hence independent of the size of the spheroid). Upon addition of nocodazole, these individual peaks disappeared, and the amplitude was reduced by a factor of 10, although the $1/f$ scaling remained. The mean exponent in *hydra* treated with nocodazole was $0.84 \pm 0.12$ ($n = 9$ regenerations).

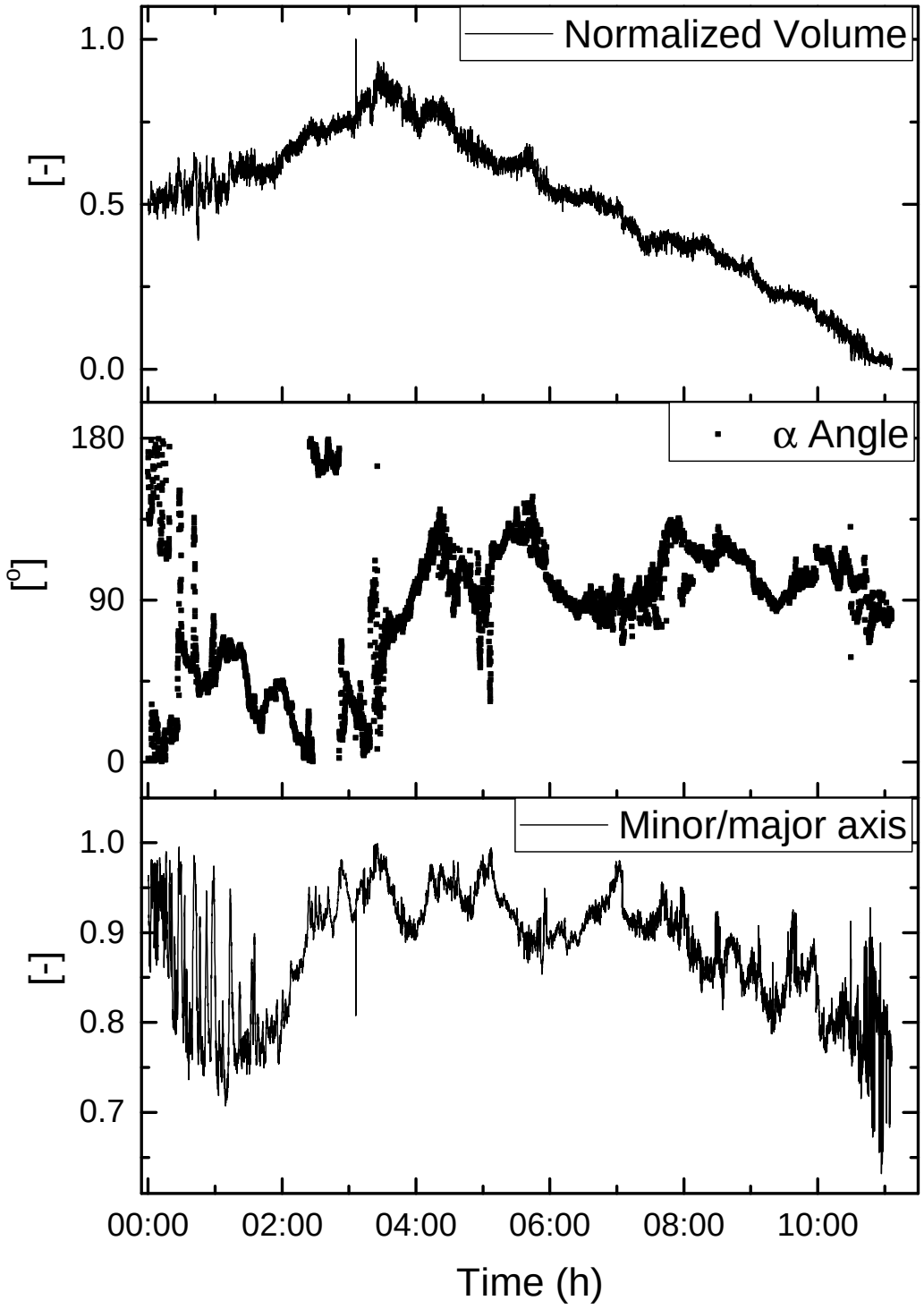


Figure 6: Shape development of a 24h nocodazole (0.1 nM) treated spheroid in nocodazole free medium. There is no sign of axis development. The spheroid slowly decays as indicated by the shrinking volume.