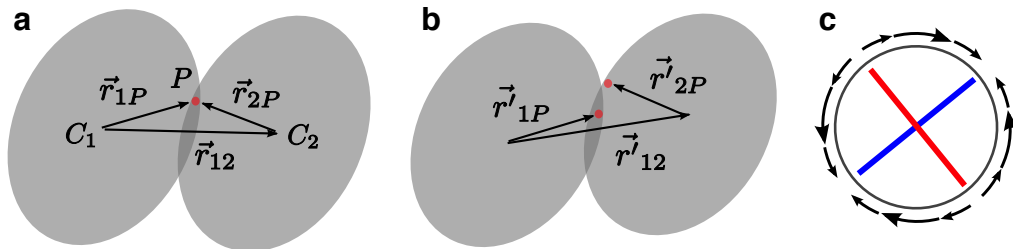
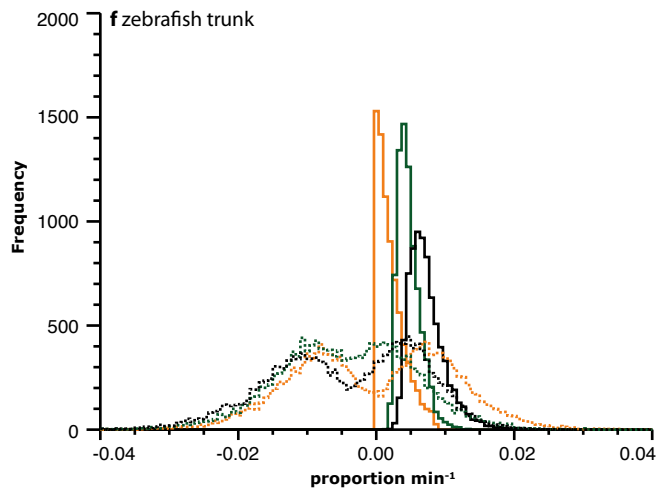
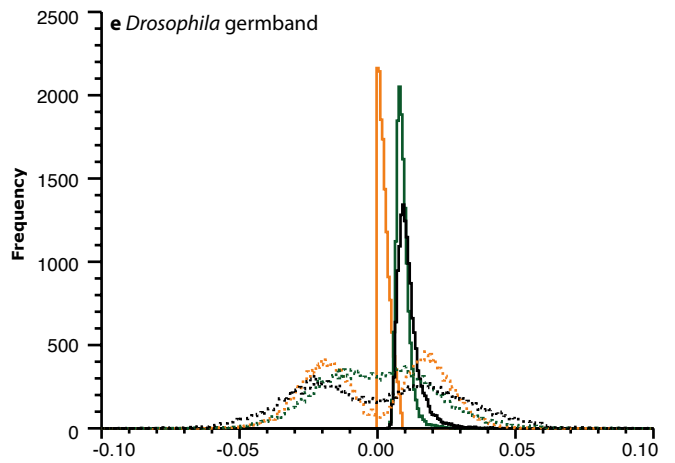
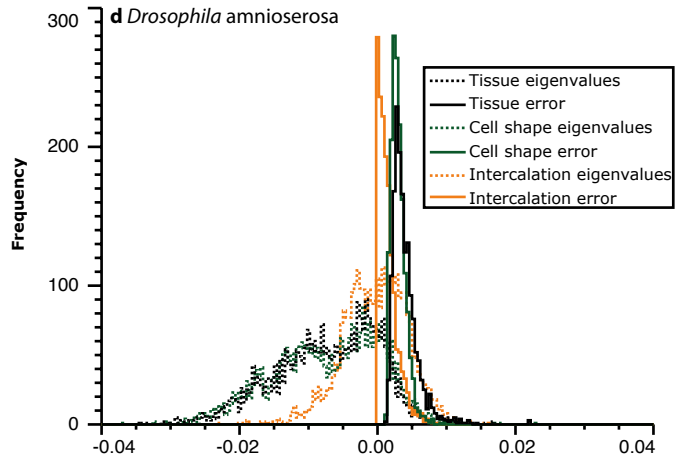
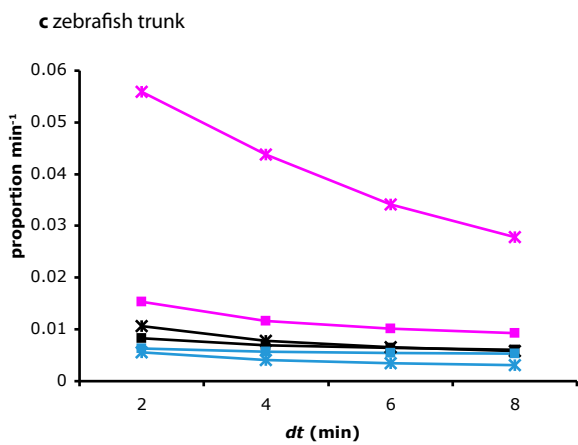
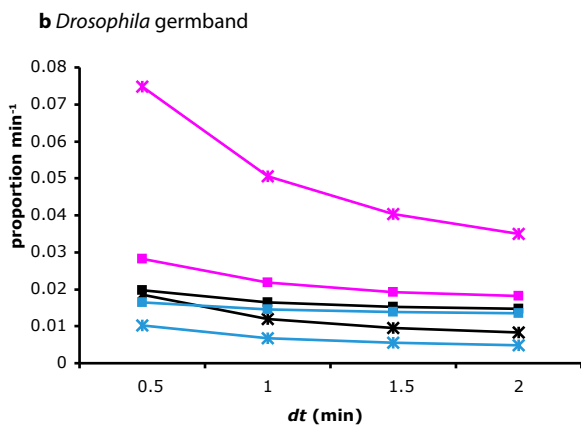
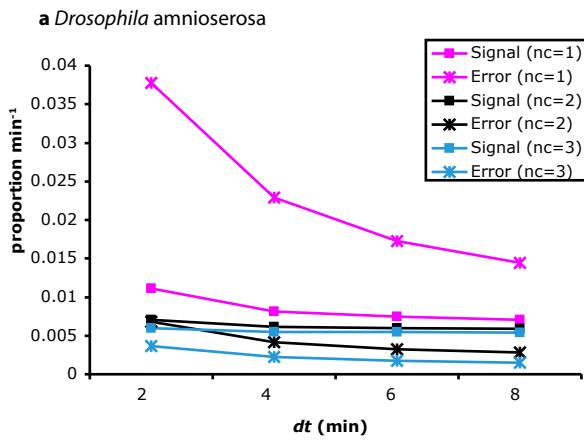


Supplementary Figure 1. Cell slippage.

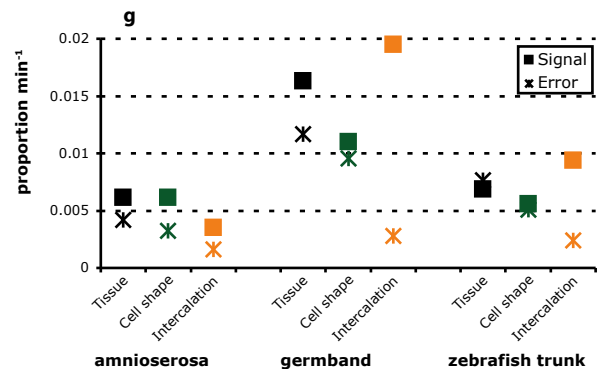


Supplementary Figure 1. Cell slippage. (a) and (b) represent the schematic evolution of two neighbouring cells whose shapes are modelled by ellipses. The points C_1 and C_2 are the cell centres. (a) corresponds to the initial state, and (b) to the configuration of the same two cells slightly later. Cell centres evolve according to the tissue velocity gradients, L_t , whereas each individual cell's shape evolves according to the cell shape strain rate, L_c . The geometrical construction of the effective slippage velocity is shown (see text for details). (c) illustrates the relationship between the intercalation tensor, L_1 (drawn as in Fig. 3h), and the mean slippage direction and velocity relative to neighbouring cells (arrows).

Supplementary Figure 2. Strain rate errors.

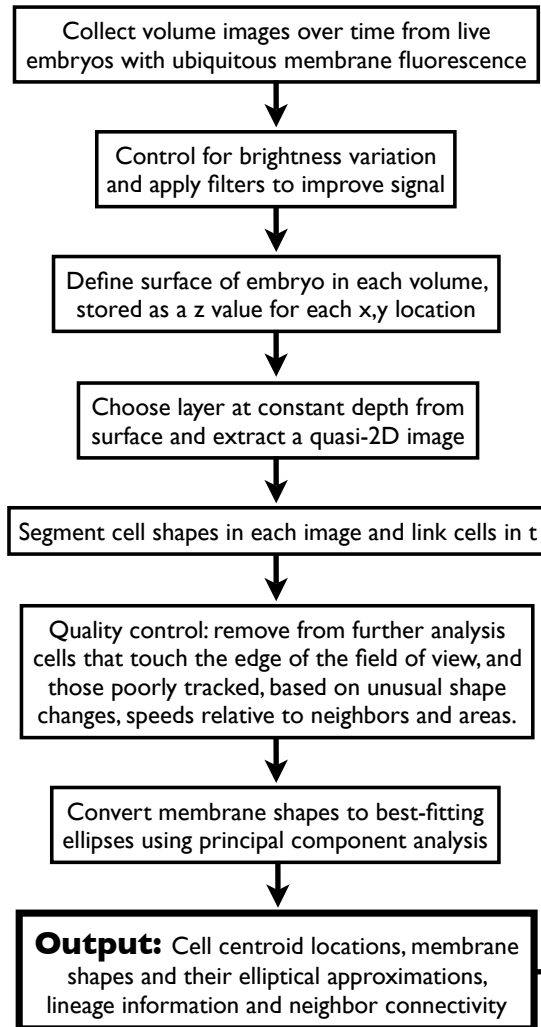


Supplementary Figure 2. Strain rate errors. (a)-(c) show the means of the error and signal distributions of L_t for three example tissues for different combinations of n_c and dt . (d)-(f) show the distributions of deformation eigenvalues for tissue, cell shape and intercalation, and their respective error distributions for $n_c = 2$ and $dt = 4$ min for (d) and (f), 1 min for (e). (g) summarizes the means of the error and signal distributions of (d)-(f).

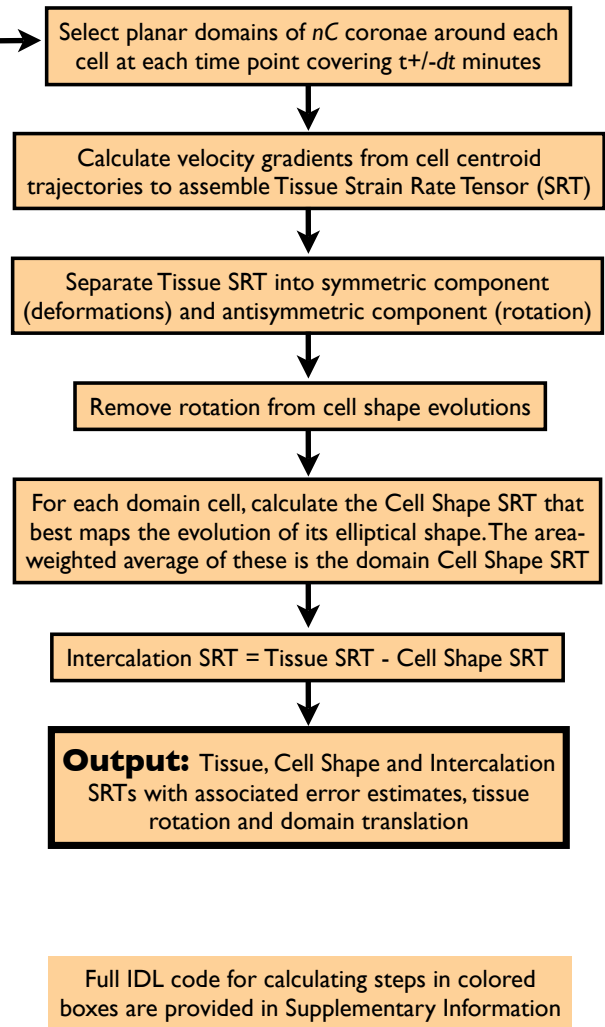


Supplementary Figure 3. Pipeline of the algorithms used to calculate strain rates from raw volume images.

IMAGE ANALYSIS & CELL TRACKING

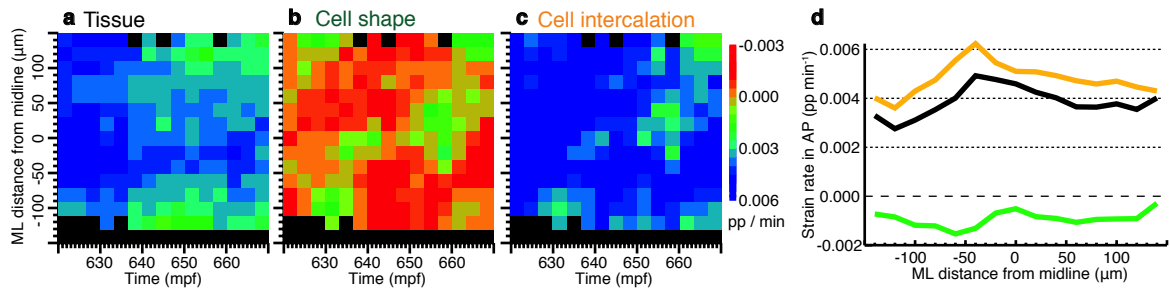


STRAIN RATE ANALYSIS



Supplementary Figure 3. Pipeline of the algorithms used to calculate strain rates from raw volume images.

Supplementary Figure 4. Strain rates at the zebrafish midline.



Supplementary Figure 4. Strain rates at the zebrafish midline. (a)-(d) show average strain rates for pre-neurulation (~10-11 hpf) zebrafish trunk ectoderm. Strain rates projected onto the AP axis are shown for the length of the movies presented in **Figure 5g,h**. Colors for average strain rates (d) are as for cumulative stretch ratios in **Figure 5**.