Extended Data Fig. 1. Example maximum event score regions which triggered EDA. The event score output by the neural network can also be used to extract events of high interest from the datasets, after the acquisition is complete. Here, events that triggered EDA in different datasets are shown. The highest event score was used to define a region of interest around the event, representing a time and location of highest interest in the sample. Some regions appear twice, when the neural network event score was high enough to trigger EDA multiple times. Frames are shown in no specific order. Scale bars: 1 µm

Extended Data Fig. 2. Bleaching behavior of a mitochondria sample during EDA imaging. The different modes of imaging can clearly be seen in the bleaching curve represented by the signal-to-noise ratio calculated from the intensity inside the mitochondria compared to the signal outside of the mitochondria. For some parts with low frame rate, even a slight recovery of signal can be observed. (representative of n = 4 independent experiments)

Extended Data Fig. 3. EDA delivers additional frames during events of interest. Top row: mitochondrial division as it would have been recorded with the slow fixed imaging rate without EDA. Vertical frames: additional frames captured thanks to EDA switching to the fast imaging speed showing more detail of the dynamics of the event. Both the final constriction state and the fade of the DRP1 peak can be observed with higher temporal resolution, enhancing the relevant content of the dataset. This division event can also be seen in Supplementary Video 3.0. (Scale bars: 1 µm, representative of N = 33 events in n = 4 independent experiments)

Extended Data Fig. 4. EDA imaging of synchronized bacteria populations. *C. crescentus*, the strain used in this study, were synchronized via density centrifugation to obtain a population of cells that are all at the beginning of their cell cycle (G0, swarmer). This leads to a time lag before the next divisions take place. As they are synchronized, many bacteria in the sample will then divide at the same time. We used EDA to sense the onset of divisions in the sample and increase imaging speed during the divisions for high SNR and temporal resolution. We tested different times between images for fast and slow speeds, as well as different threshold event scores (grey band). **a,** slow: 9 min, fast 3 min. **b and c,** slow: 12 min, fast 2 min. (Scale bar: 1 µm, n = 4 independent synchronizations)