

**Supplementary Materials:  
Multiscale geometrical and topological learning in the analysis of  
soft matter collective dynamics**

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**I. LIST OF SUPPLEMENTARY VIDEOS**

- **Supplementary Video 1.** Shear-like deformation of a pseudocrystallite, which is a dense-packed ensemble of particle-like soft structures.
- **Supplementary Video 2.** Movement of a dense-packed ensemble, accompanied by a shape transformation of individual pattern-forming structures.
- **Supplementary Video 3.** Formation of moving chains and clusters of particle-like structures from their dense-packed ensemble.

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## II. SUPPLEMENTARY FIGURES

### A. Supplementary figure to Figure 4

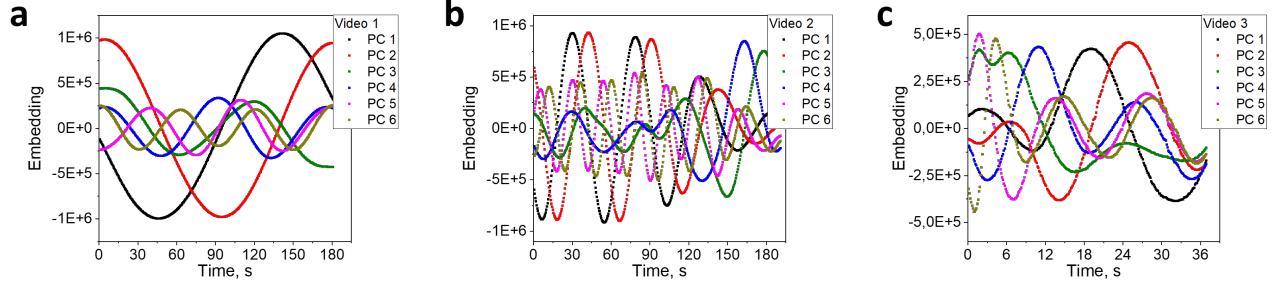


FIG. S1. Time dependencies of the first six principal components (PCs) for the corresponding videos. The cases of **a**, a moving ensemble of shape-persistent soft quasi-particles, **b**, densely packed quasi-particles experiencing shape transformation, **c**, clustering quasi-particles.

## B. Supplementary figures to Figure 5

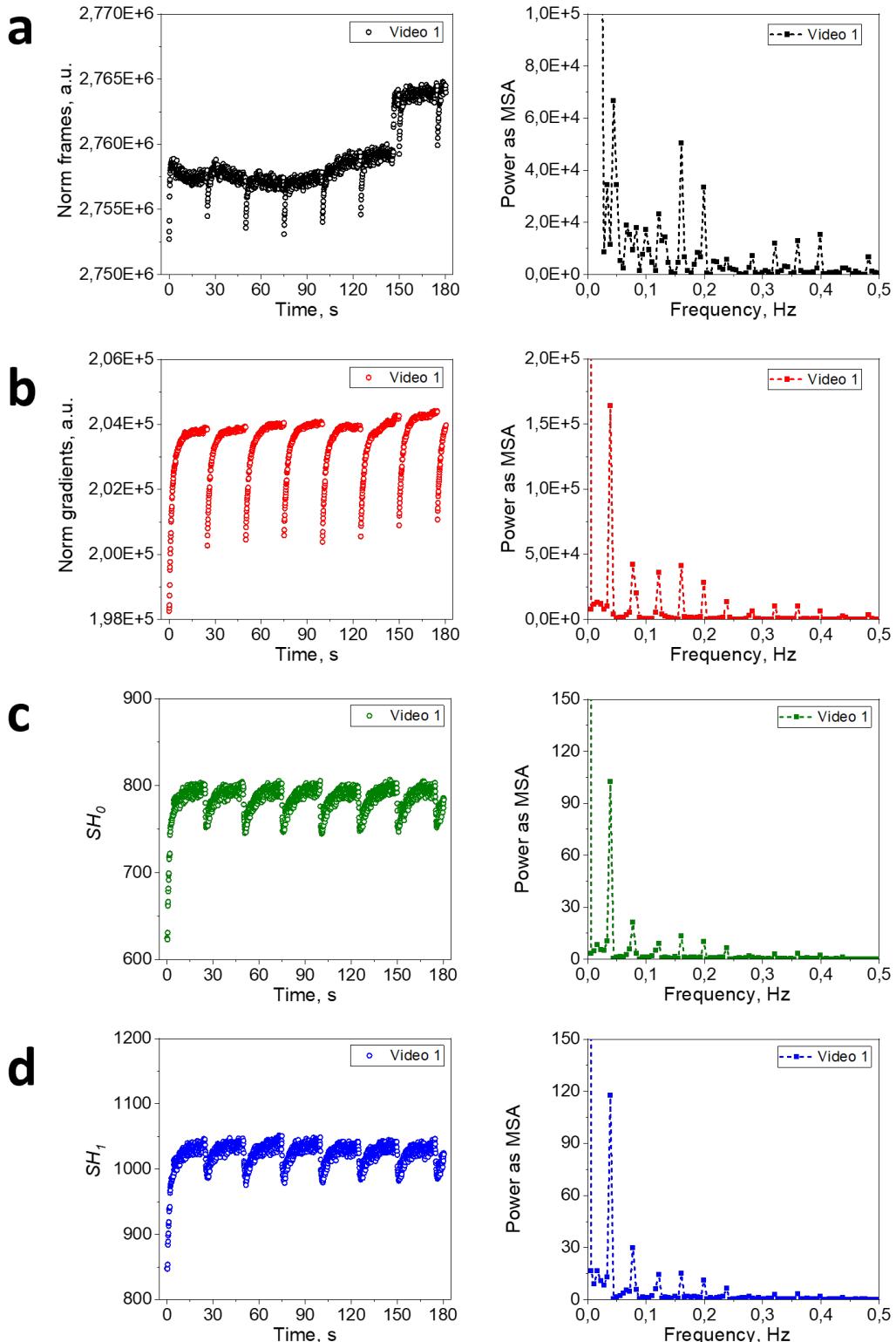


FIG. S2. L1 norm of frame characteristics and persistence data computed for Supplementary Video 1. **a**, norm of video frames, **b**, norm of video frame gradients, **c**, norm of 0th persistence, **d**, norm of 1st persistence.

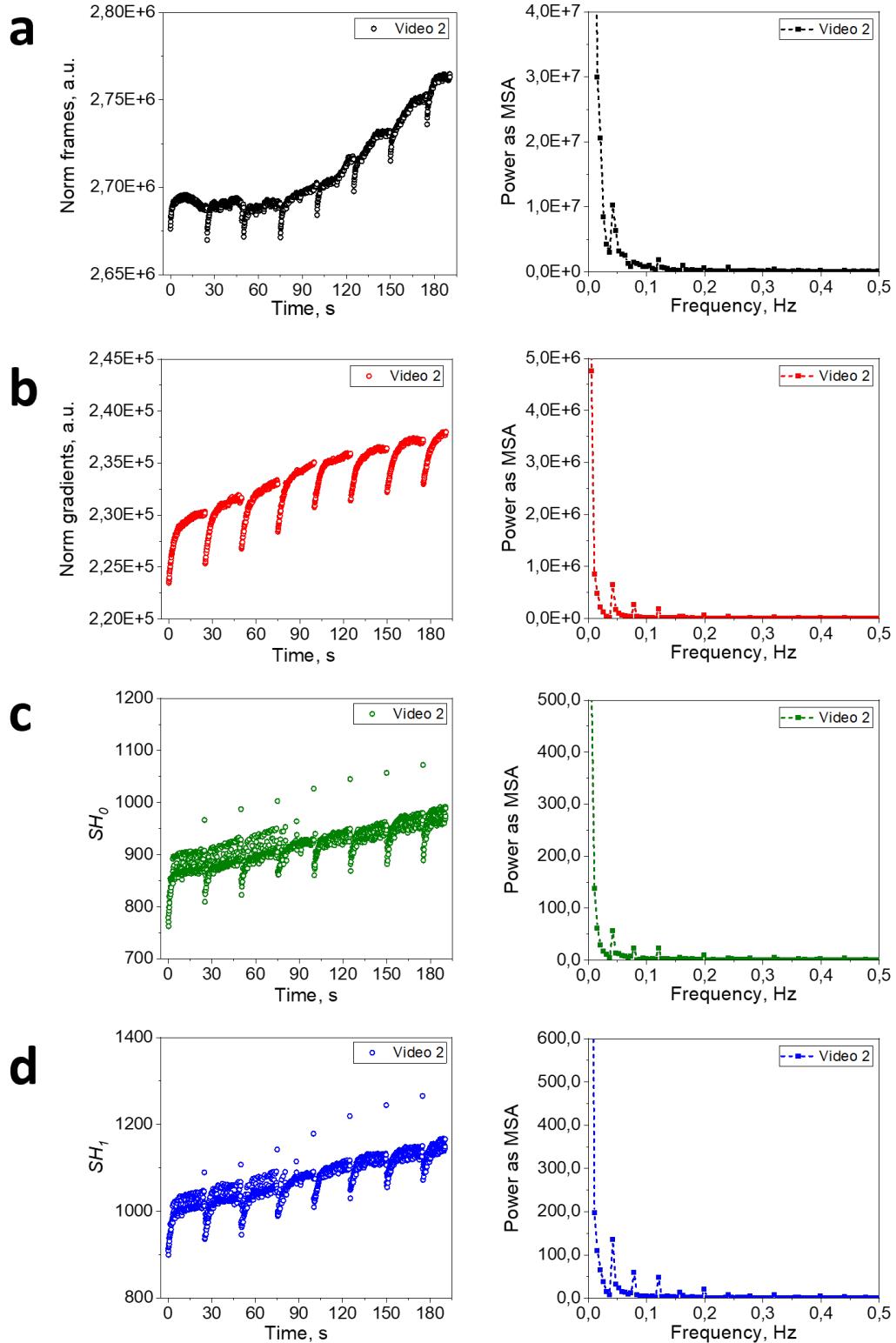


FIG. S3. L1 norm of frame characteristics and persistence data computed for Supplementary Video 2. **a**, norm of video frames, **b**, norm of video frame gradients, **c**, norm of 0th persistence, **d**, norm of 1st persistence.

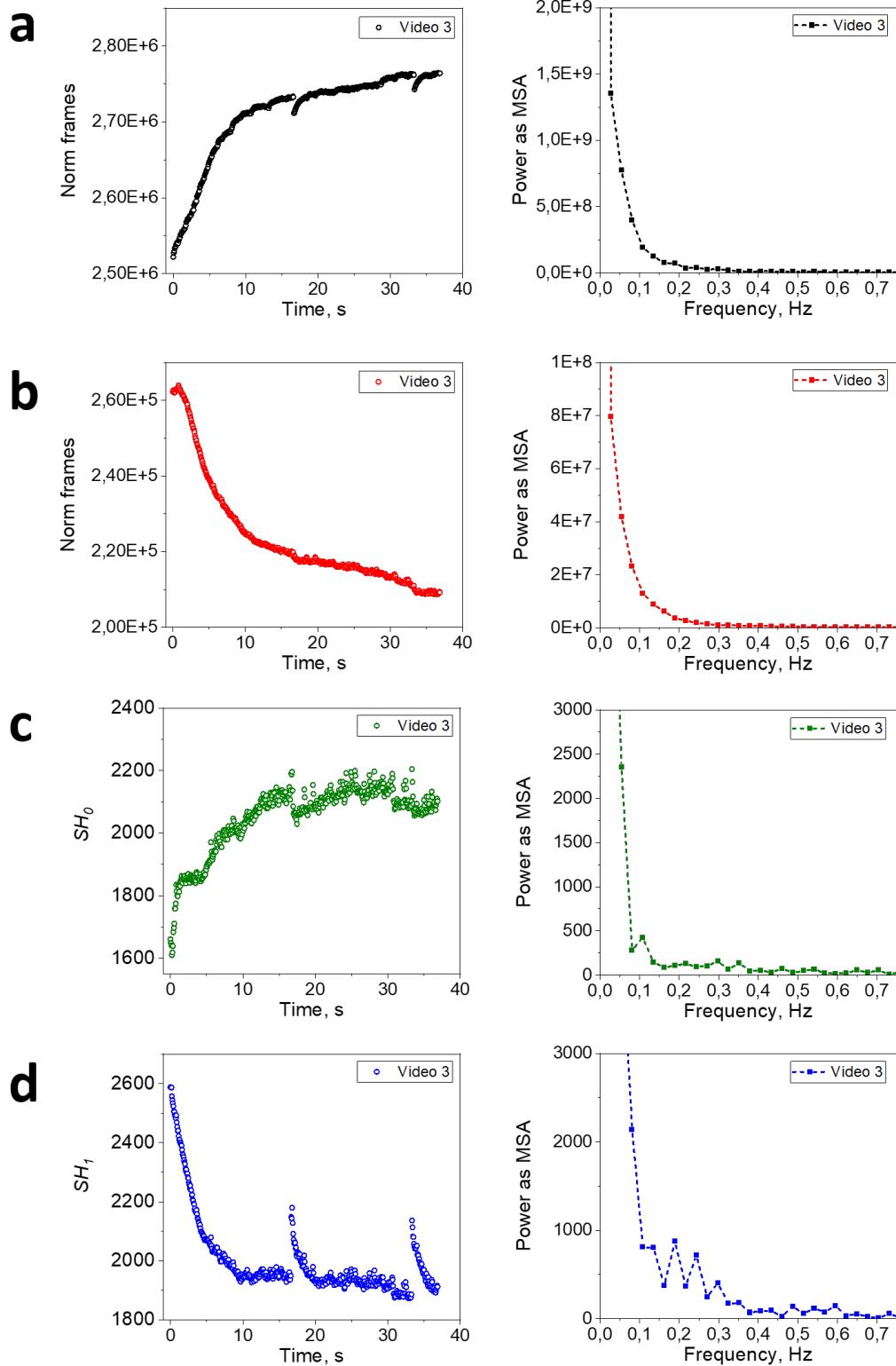


FIG. S4. L1 norm of frame characteristics and persistence data computed for Supplementary Video 3. **a**, norm of video frames, **b**, norm of video frame gradients, **c**, norm of 0th persistence, **d**, norm of 1st persistence.

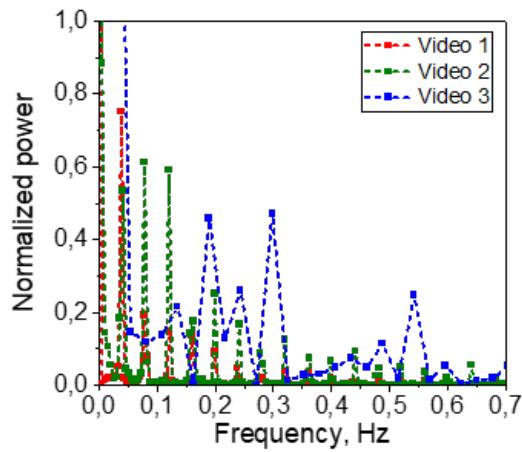


FIG. S5. Normalized power spectra shown in Fig. 4 d-f. The power values are normalized to the corresponding maximum values in each of Fig. 4 d-f.