

RhythmWriter: GPU-accelerated Contractility Quantification for Large Datasets

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McGill

INTRODUCTION

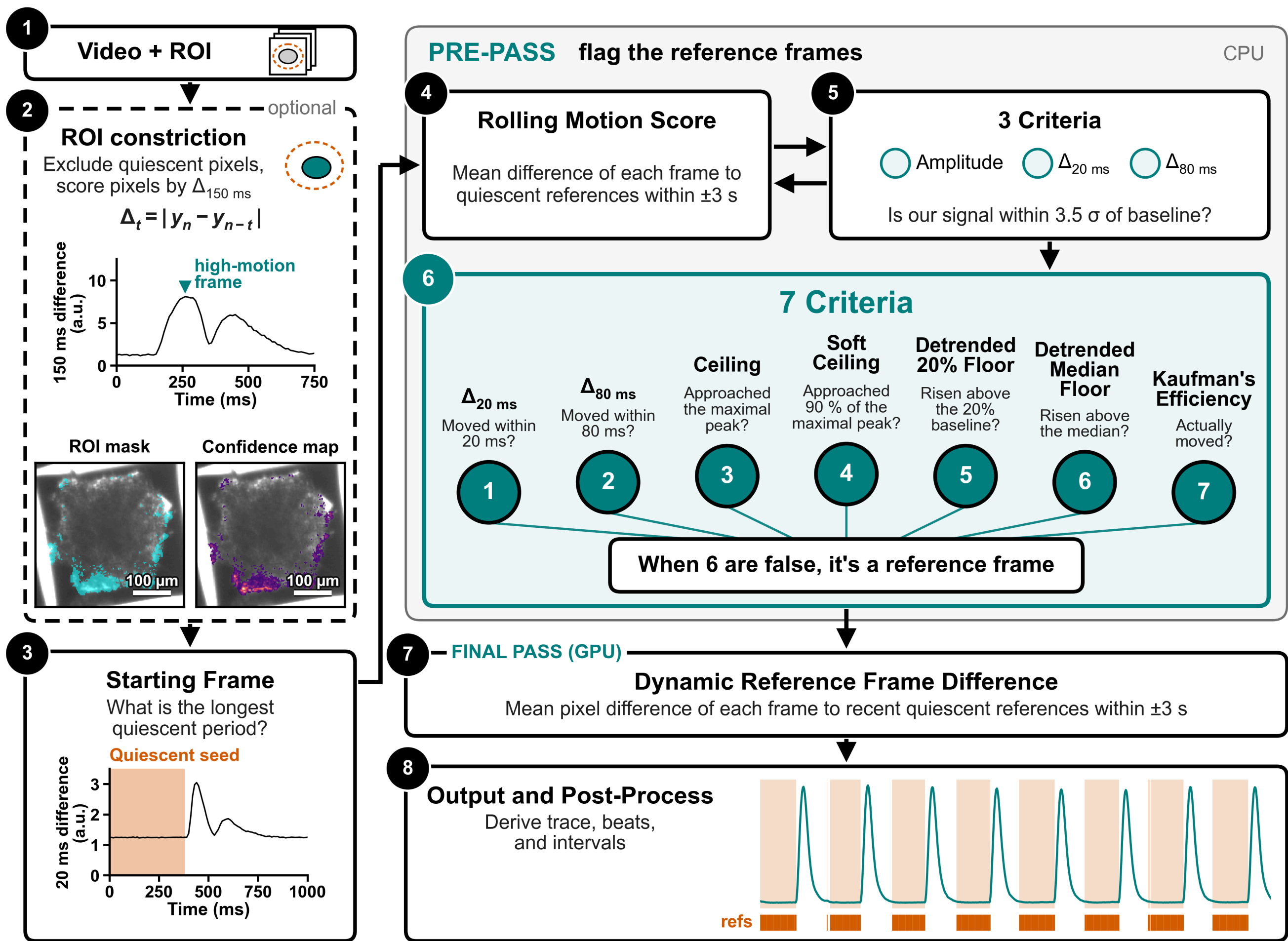
Contractility algorithms struggle to follow long recordings

Human induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs) are a highly relevant human cardiac model for proarrhythmic assessment. Despite recommendations by regulators, hiPSC-CMs remain underutilized during drug development largely due to technical limitations. Recent methods to measure contractile motion have successfully derived proarrhythmic classifiers but are limited to short datasets.

RhythmWriter overcomes these throughput limitations by attaining drift-immunity, time-scale invariability, and robustness to rapid pacing frequencies. As a consequence, it is capable of generating simultaneous high-resolution contraction restitution curves from multiple aggregates of hiPSC-CMs derived from premature-stimulus (S1S2) and dynamic-ramp restitution protocols.

METHODS

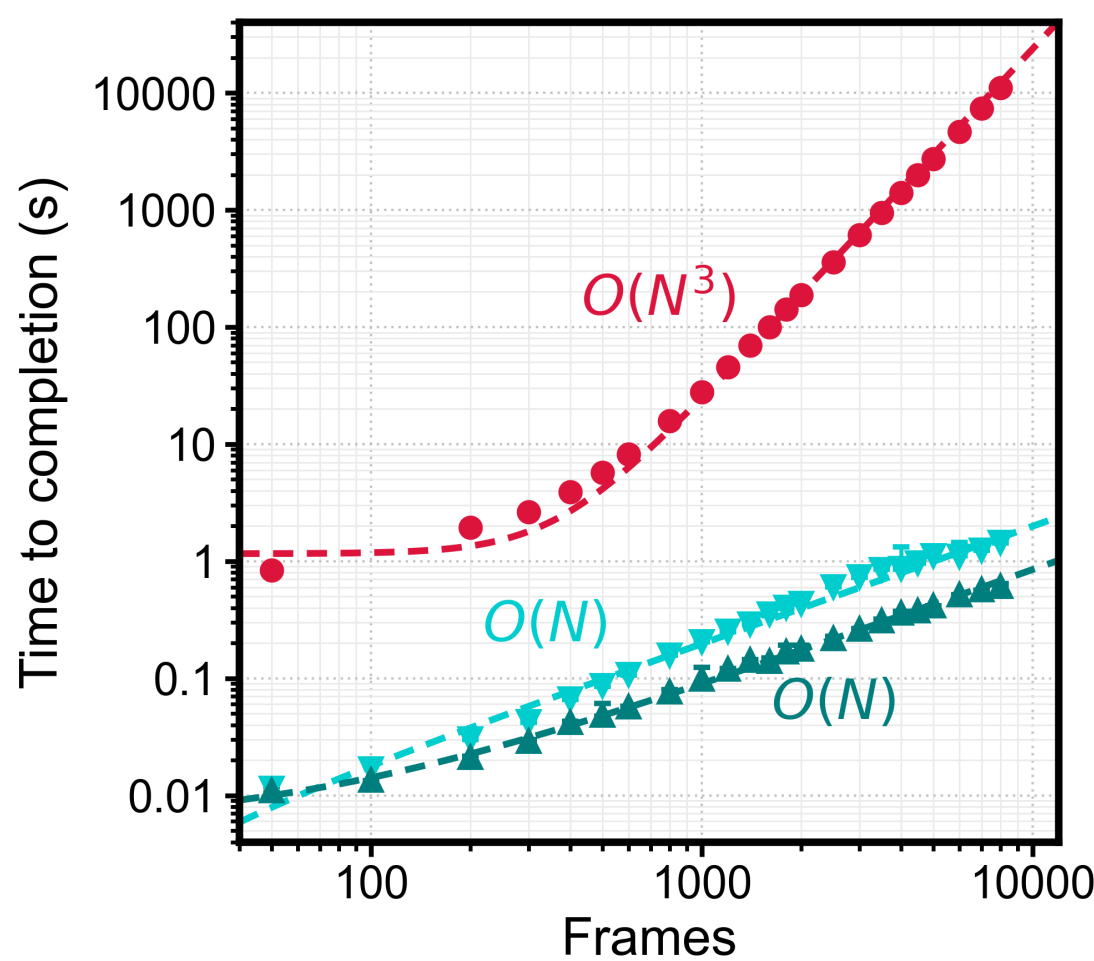
RhythmWriter Flowchart



RESULTS

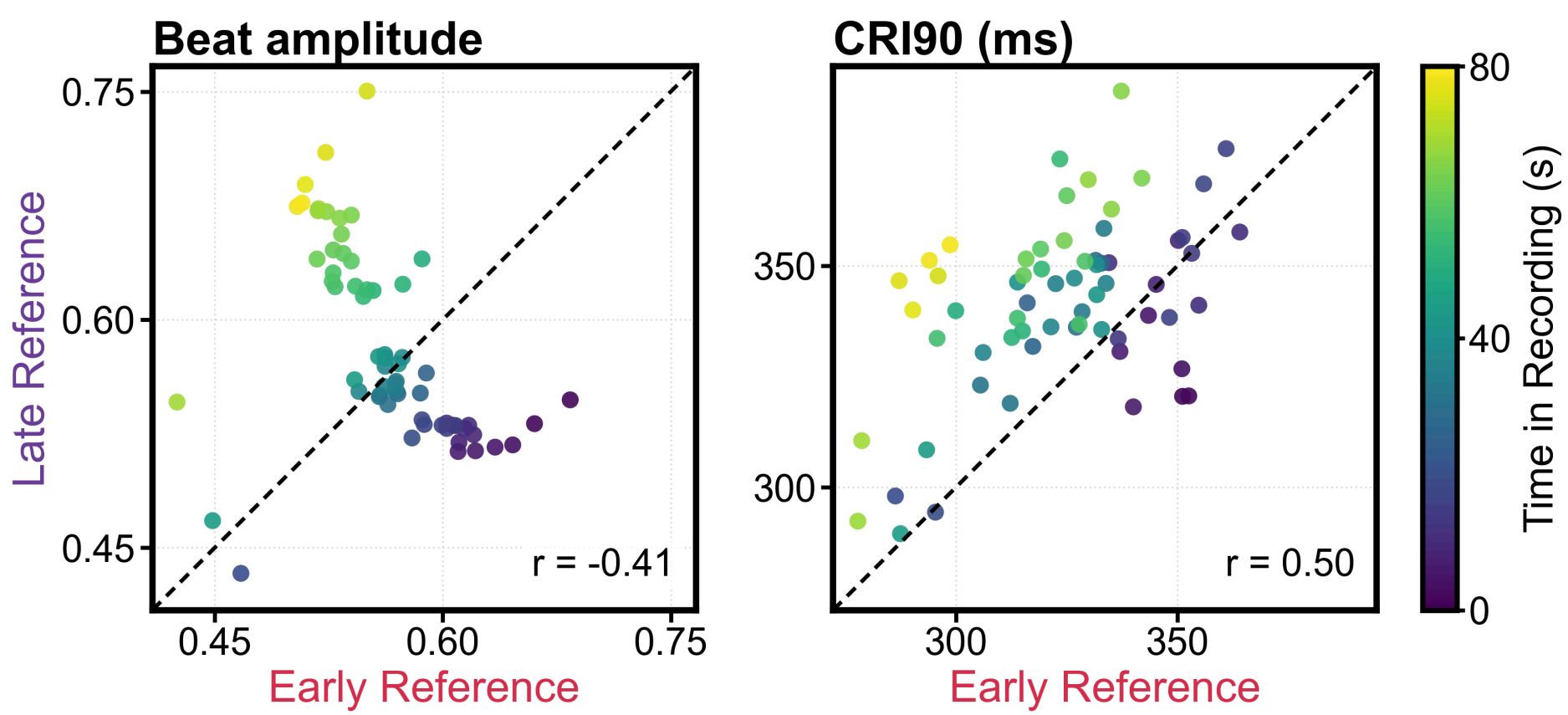
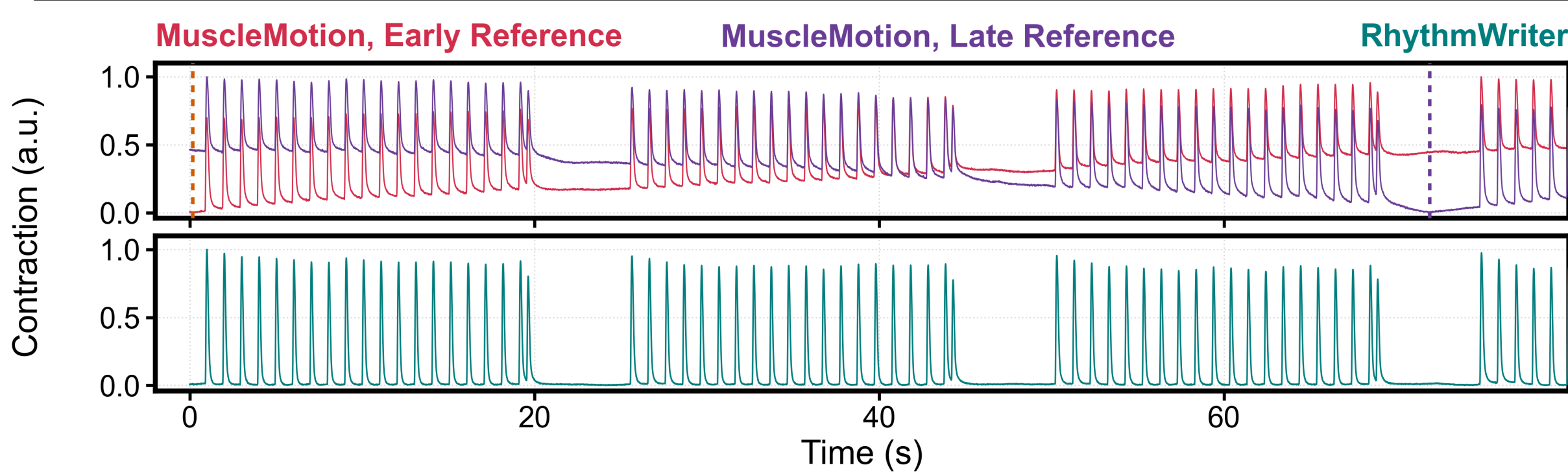
RhythmWriter is fast and drift-immune

High Computational Speed



$y = a + k \cdot N^b$	N frames, y seconds			
	a (ms)	k (s·frame ^{-b})	b	R ²
● MUSCLEMOTION	1158.7	2.38×10^{-8}	3	0.995
▼ RhythmWriter iGPU	-2.1	1.99×10^{-4}	1	0.985
▲ RhythmWriter RTX 5070	5.7	8.43×10^{-5}	1	0.995

No Baseline Drift



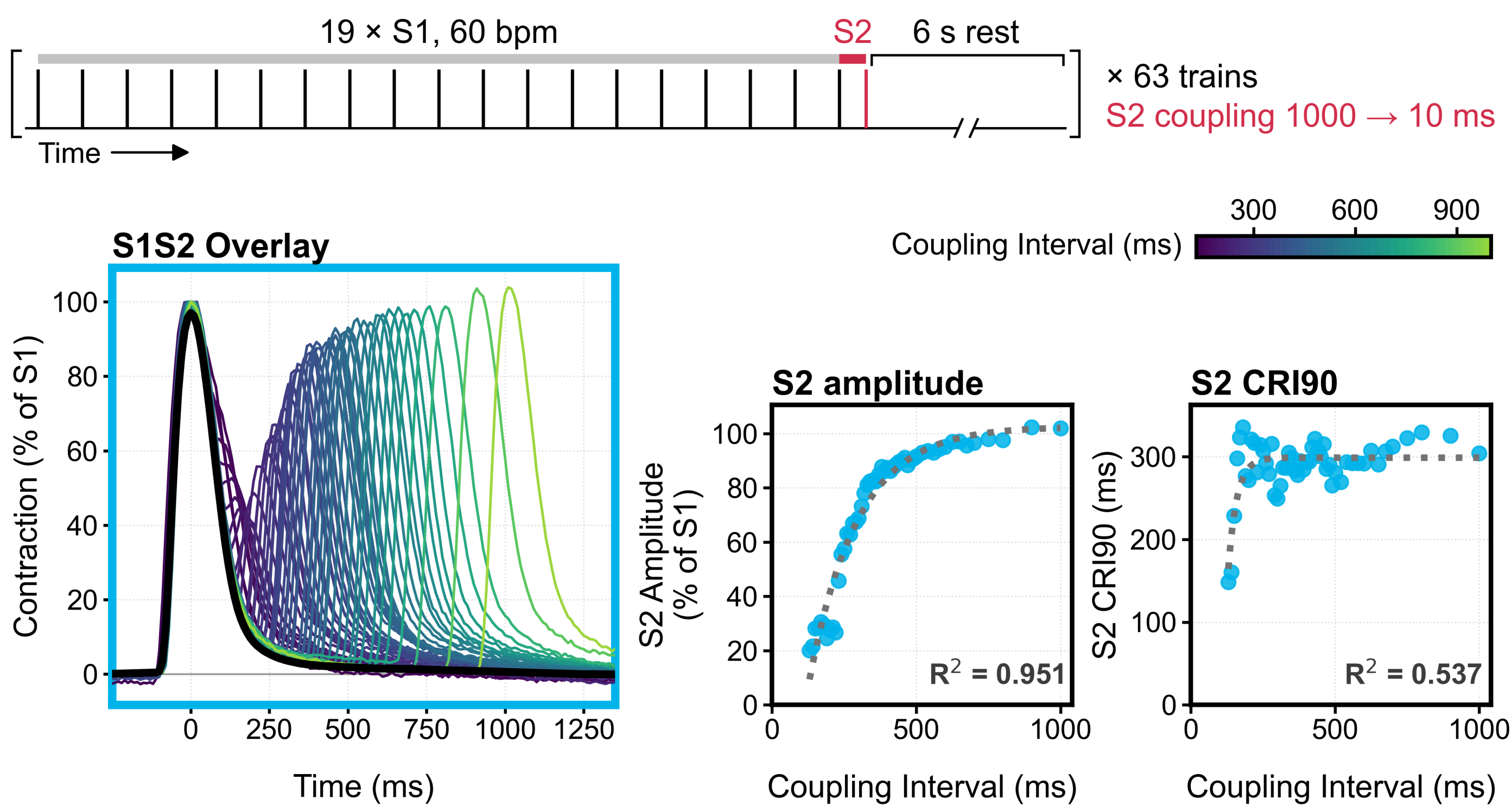
CONCLUSIONS

- RhythmWriter is fast, drift-immune and time-scale invariant.
- Permits high-throughput analysis.
- Makes possible combined S1S2 and dynamic mechanical restitution experiments on hiPSC-CMs optically.
- Enables long-term functional assessment of hiPSC-CMs, with applications in drug safety, disease modelling, and CM maturation.

RESULTS

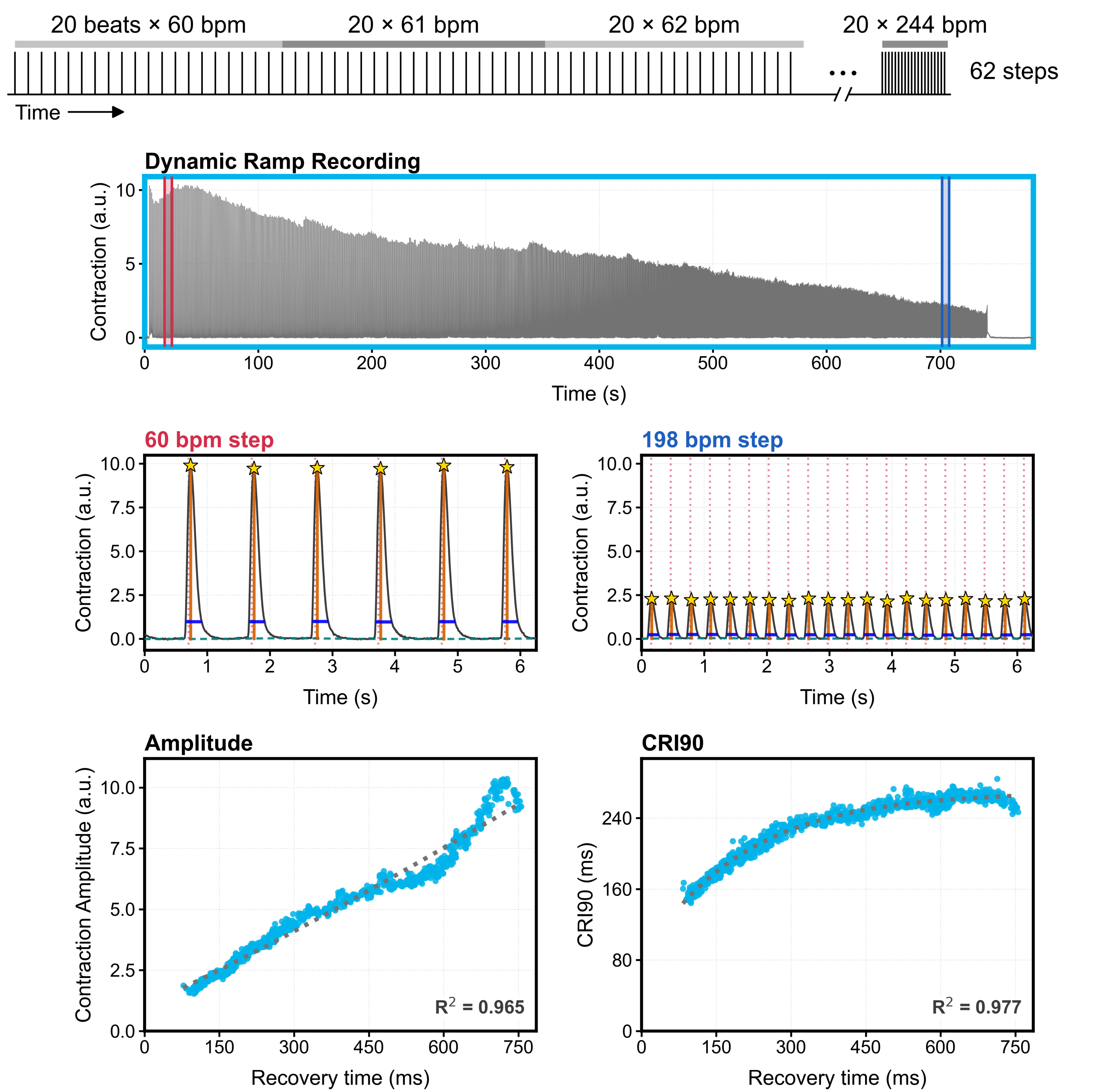
S1S2 Mechanical Restitution

AGGREGATE 2

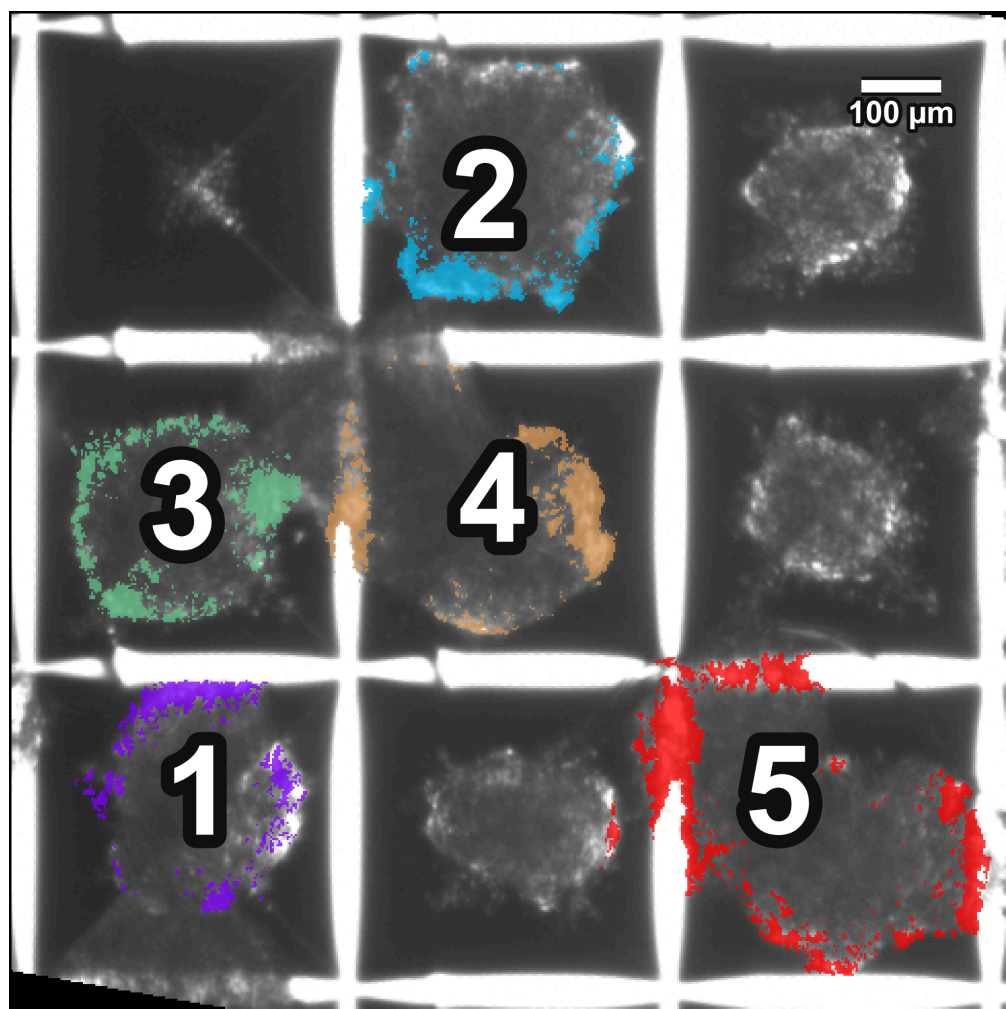


Dynamic Mechanical Restitution

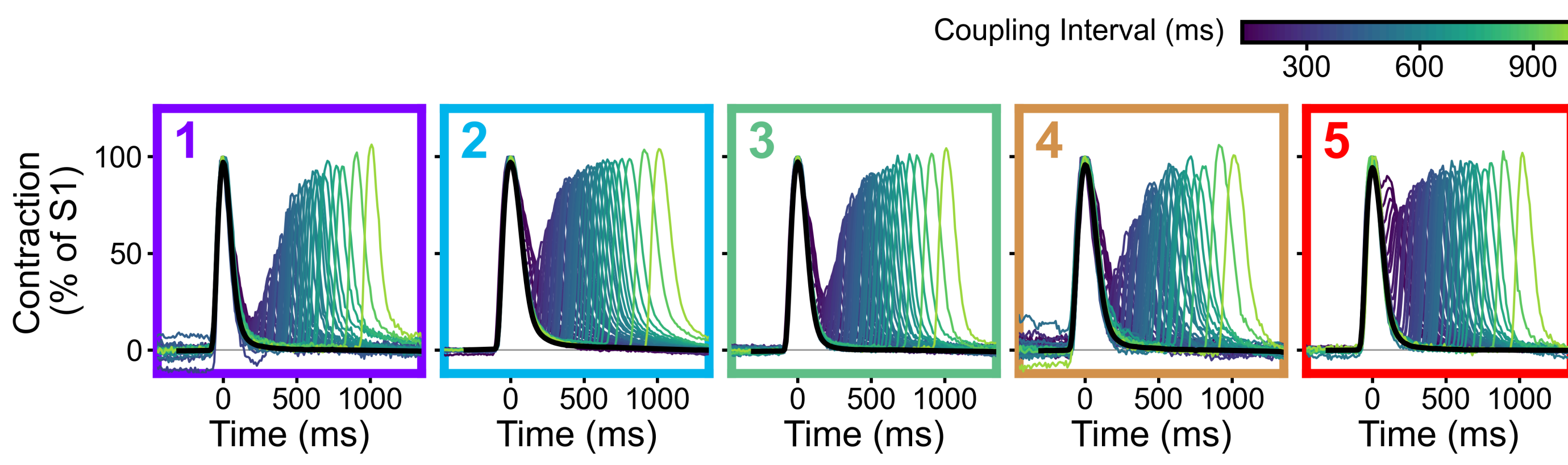
AGGREGATE 2



RhythmWriter is high throughput



Five aggregates in one field of view were analyzed in one dataset, each from its own region of interest in sequence. Each aggregate was recorded for 45 min at 100 fps. Analyzing all 1,360,205 frames took 3.7 min.



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