Real-time Adaptive Mapping of Multiple Cardiac Rhythms Using a Deep Learning-Based Beat-Grouping Method

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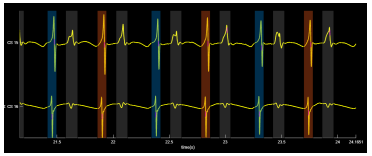
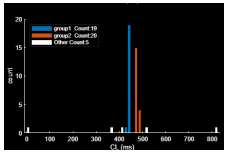
Background

- Conventional cardiac mapping is restricted to a single rhythm, requiring restart of mapping when rhythm changes.
- Deep learning (DL)-based beat-grouping adapts to changing rhythms and streamlines clinical workflow.



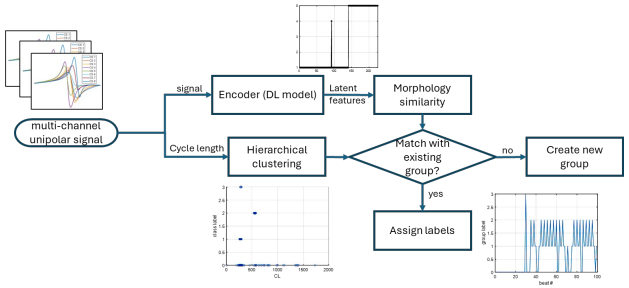


Objective(s)

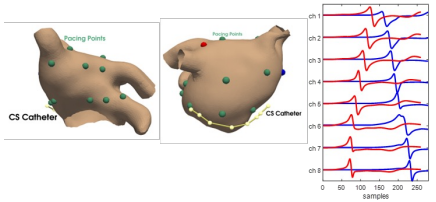
Evaluate accuracy of a DL-based beat-grouping method for automatic, continuous, real-time acquisition of multiple rhythms using simulated and preclinical data.

Method

- A DL model was trained on an ECG database to distinguish physiologically relevant signal features.
- These features were combined with cycle-length (CL) to create rhythm templates and group beats in real-time.



- Twenty-two focal activation patterns with 9 CLs were simulated on 2 MRI-segmented left atria.
- Coronary sinus unipolar electrograms were computed from a forward model, concatenated, and streamed as real-time inputs to the DL model.



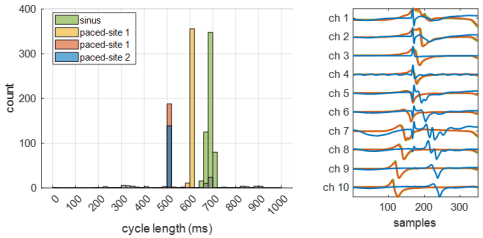
- Preclinical validation included 11 paced and 2 sinus rhythms from 4 swine.
- Accuracy was assessed using F-score, precision, and recall in 3 modes: CL only; morphology only; and combined.

Results

All groups in simulation and preclinical data were accurately detected, with overall precision of 98% in preclinical data.

	Simulation			Preclinical
Grouping mode	CL	Morphology	Morphology + CL	Morphology + CL
Test Samples	44	24	24	4
# of Beats	3727	4071	4108	4761
Total # of groups	390	48	429	13
F score	0.977	0.966	0.947	0.963
Precision	0.982	0.965	0.953	0.976
Recall	0.977	0.971	0.948	0.9505
CL error (ms)	15.1	N/A	15.23	N/A

Preclinical Validation



Conclusion

DL-based method accurately identified rhythms across all grouping-modes, enabling continuous mapping of multiple cardiac rhythms that can improve clinical workflow.