



# A Novel Method to Filter Out Pacing Artifacts From Electrocardiograms

## Facilitating Automated Voltage-Time-Integral Measurement

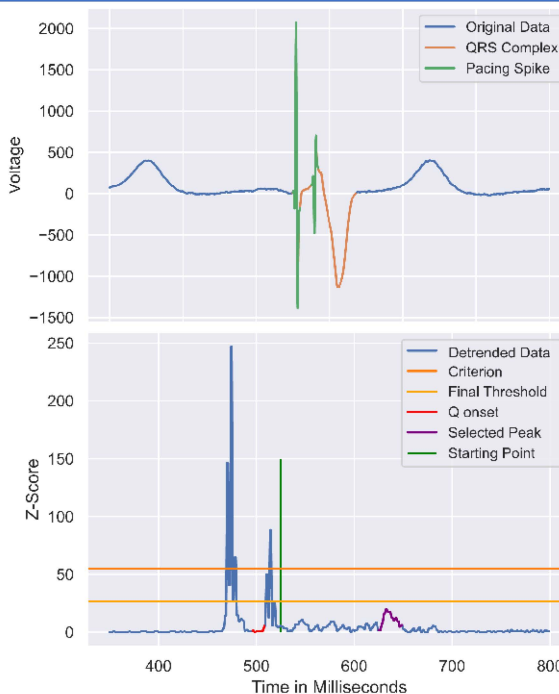
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### Methods

- We devised a two-step filter. First, the true QRS is identified as the peak within the QRS complex that is lower than the 98th percentile of the modified Z-score of detrended data plus 40.
- The pacing outlier filter deletes all data above this value and fills the gap with a b-spline interpolation function.
- The b-spline function recreates the entire signal minus the gap. We then only update the values which are blank using the recreated signal.
- Second, a median filter is applied to eliminate residual noise.

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# Results

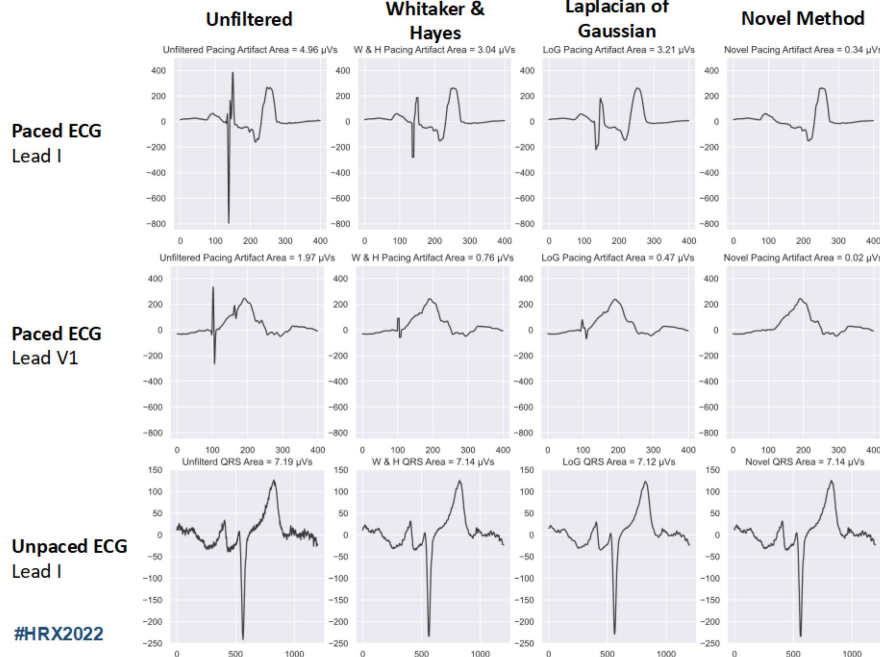
- Our novel method had the greatest diminution of the pacing artifact on ECG.
- Our novel method had the least impact on true ECG signal.

	ECGs with <u>pacing artifacts</u> (n=360*)		ECGs with no pacing (n=360*)	
	<u>Pacing artifact</u> <u>peak-to-peak</u> <u>amplitude</u> (mV)	<u>Pacing artifact</u> <u>VTI/area</u> (μVs)	<u>QRS</u> <u>VTI/area</u> (μVs)	p-value
Unfiltered	1.59 ± 1.36	5.28 ± 4.71	35.5 ± 20.1	
Whitaker & Hayes	0.36 ± 0.36	1.98 ± 2.35	35.2 ± 20.0	3x10 <sup>-06</sup>
Laplacian of Gaussian	0.39 ± 0.34	0.91 ± 1.68	34.1 ± 19.7	2x10 <sup>-05</sup>
<b>Novel Method</b>	<b>0.02 ± 0.04</b>	<b>0.05 ± 0.43</b>	<b>35.1 ± 19.9</b>	<b>1x10<sup>-05</sup></b>

\* 360 individual leads from 30 twelve-lead ECGs  
p-values are from pairwise t-test comparison to unfiltered VTI, Voltage-Time-Integral



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**Our novel filtering method effectively eliminates electrical pacing artifact without affecting the true ECG signal.**



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**Thank you.**

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