Paper link

HiMAE: Hierarchical Masked Autoencoders Discover Resolution-Specific Structure in Wearable Time Series

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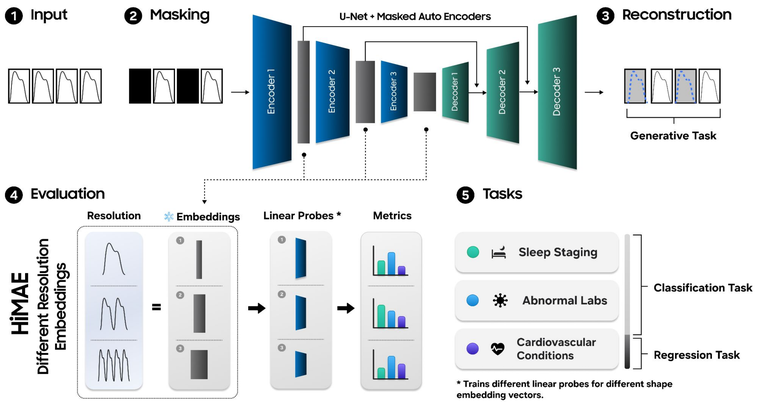
Introductions

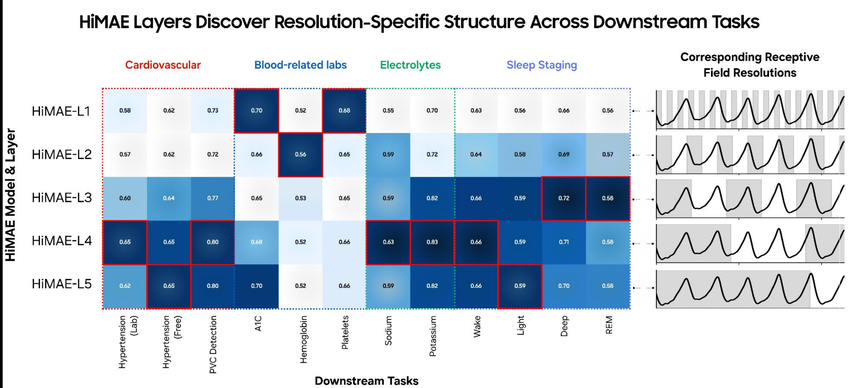


Research problem: There is very limited understanding on whether signal resolution plays a role in downstream evaluation.

Our works Contributions: Can we design an SSL framework that can study how resolution plays a role in downstream evaluation.

Additional Contributions: Our framework is substantially smaller than existing SSL frameworks, enabling on-device deployment and real-time inference. To our knowledge, this represents the first wearable modeling framework capable of running fully on-device.

Resolution Hypothesis

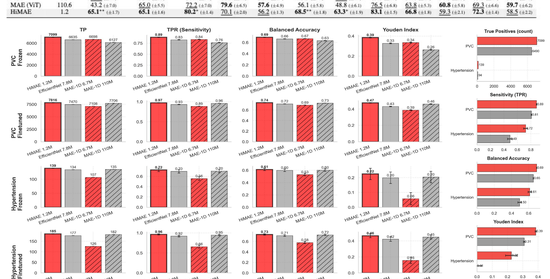


Main Figure: The results suggest that distinct signal resolutions yield maximal performance across different downstream evaluation tasks, indicating resolution-specific structure in wearable time series representations.

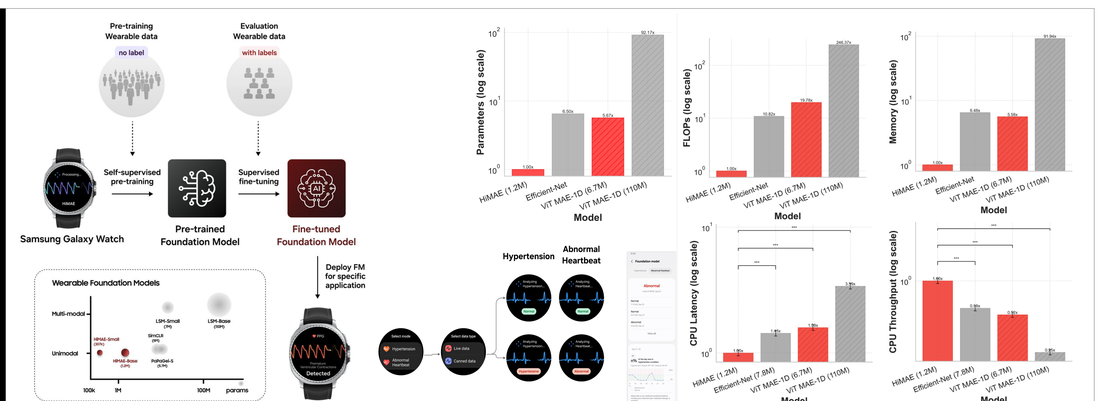
Downstream Tasks

Model	#param (M)	Cardiovascular Conditions			Abnormal Blood Labs					Sleep Staging			
		Hyptn (lab)	Hyptn (free-living)	PVC	A1C	Hemoglobin	Platelets	Sodium	Potassium	Wake	Light	Deep	REM
PaPaGei-BL	5.7	57.3 (±4.7)	60.9 (±4.1)	74.2 (±4.6)	59.2 (±3.9)	58.5 (±3.2)	59.9 (±3.9)	59.0 (±3.5)	75.5 (±3.5)	56.8 (±4.9)	55.6 (±5.6)	53.9 (±5.5)	56.3 (±5.5)
PaPaGei-SRA	5.7	59.3 (±3.5)	62.9 (±3.7)	75.2 (±5.6)	61.2 (±4.1)	60.5 (±2.7)	61.9 (±3.6)	61.0 (±3.7)	77.5 (±4.6)	56.8 (±4.2)	57.6 (±3.7)	55.9 (±3.4)	58.3 (±4.1)
Swin-Transformer	110.6	58.3 (±4.2)	61.9 (±5.8)	74.2 (±7.2)	58.2 (±4.7)	59.3 (±4.8)	60.9 (±4.7)	60.0 (±5.6)	76.5 (±4.8)	56.7 (±5.4)	54.7 (±6.1)	53.3 (±7.5)	54.4 (±5.1)
Chronos	200.0	67.3 (±4.7)	59.9 (±2.9)	65.7 (±3.1)	58.2 (±3.4)	53.6 (±3.5)	60.9 (±2.7)	63.3 (±2.3)	63.5 (±2.6)	64.9 (±3.7)	63.2 (±2.2)	72.2 (±2.7)	57.3 (±2.9)
HiMAE	1.2	65.1 (±4.7)	65.3 (±3.4)	80.2 (±3.4)	70.1** (±2.0)	56.2 (±3.3)	68.5** (±1.8)	63.3 (±1.9)	83.1* (±1.5)	66.5 (±1.8)	59.3 (±2.1)	72.3 (±1.4)	58.5 (±2.2)

Model	#param (M)	Cardiovascular Conditions			Abnormal Blood Labs					Sleep Staging			
		Hyptn (lab)	Hyptn (free-living)	PVC	A1C	Hemoglobin	Platelets	Sodium	Potassium	Wake	Light	Deep	REM
SimCLR	5.0	53.4 (±3.6)	53.7 (±4.1)	51.7 (±3.9)	60.9 (±3.5)	50.8 (±4.6)	44.4 (±4.2)	58.6 (±4.4)	67.0 (±4.9)	56.6 (±4.3)	52.7 (±3.5)	67.0 (±4.8)	51.0 (±5.7)
DINO	6.5	51.7 (±4.8)	52.2 (±3.4)	47.0 (±4.8)	58.9 (±3.9)	49.6 (±3.2)	42.9 (±5.6)	56.9 (±3.3)	64.5 (±3.8)	55.3 (±3.4)	55.2 (±4.4)	68.8 (±3.3)	46.0 (±6.0)
MSN	2.5	55.2 (±4.5)	55.0 (±2.5)	56.4 (±3.6)	62.9 (±2.2)	52.1 (±3.5)	45.9 (±3.7)	60.4 (±2.3)	69.5 (±3.5)	57.8 (±2.7)	50.3 (±3.9)	65.3 (±2.8)	56.0 (±3.5)
MAE (ViT)	110.6	43.2 (±7.0)	45.0 (±5.5)	72.2 (±7.0)	79.6 (±4.7)	57.6 (±4.9)	56.1 (±5.8)	48.8 (±6.1)	76.5 (±4.8)	63.8 (±5.3)	60.8 (±5.8)	69.3 (±4.6)	59.7 (±6.2)
HiMAE	1.2	65.1** (±3.7)	65.1 (±3.6)	80.2* (±3.4)	70.1 (±2.0)	56.2 (±3.3)	68.5** (±1.8)	63.3** (±1.9)	83.1* (±1.5)	66.5 (±1.8)	59.3 (±2.1)	72.3 (±1.4)	58.5 (±2.2)



On Device Capabilities



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