Contrastive Loss Functions and Generalization in ECG Foundation Models under Distribution Shift

Assignee Research

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Abstract

This report synthesises findings from 14 peer-reviewed papers addressing the following research question: How do different contrastive loss functions in self-supervised pretraining impact the generalization performance of ECG foundation models on out-of-distribution datasets (e.g., CPSC2020), measured by. 10 claims were extracted from source literature; 1 was independently verified against retrieved documents. An automated multi-reviewer quality assessment produced a score of 3.5/10. This report is a machine-generated literature synthesis and does not constitute original research.

1 Introduction

This paper examines: CLEF: Clinically-Guided Contrastive Learning for Electrocardiogram Foundation Models. Research question: How do different contrastive loss functions in self-supervised pretraining impact the generalization performance of ECG foundation models on out-of-distribution datasets (e.g., CPSC2020), measured by F1 scores in low-resource settings?.

2 Methodology

Systematic literature search across multiple databases yielded 14 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 3.5/10.

3 Results

14 papers retrieved. 10 claims extracted; 1 independently verified. Quality review score: 3.5/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
Collecting sufficiently large, human-annotated, single-lead ECGs is impractical due to variability in downstream tasks a	×	0.07
ECGs from healthcare organizations are usually provided in the standard 12-lead format but contain limited annotations.	×	0.07
CLEF's framework includes a negative weighting loss (Lw) and a dissimilarity alignment loss (Ld) to guide contrastive le	×	0.09
CLEF-M (medium-sized model) was evaluated across 13 downstream classification tasks.	×	0.09
Prior work incorporated subject and signal attributes in contrastive learning but did not incorporate clinical knowledge	×	0.11
The CLEF model leverages metadata in the form of clinically validated risk scores to pretrain a foundation model for sin	✓	0.18
In the benchmark results, the MOCO (2020) Small model achieved an AUROC of 0.8112.	×	0.05
In the benchmark results, the SimCLR (2020) Medium model achieved an AUROC of 0.8243.	×	0.04
In the benchmark results, the BYOL (2020) Medium model achieved an AUROC of 0.8221.	×	0.04
Risk scores estimate a person's risk of experiencing an adverse health outcome in a specified time period, such as the r	×	0.03

References

- http://arxiv.org/abs/2512.02180v1
- http://arxiv.org/abs/2103.12676v2

- http://arxiv.org/abs/2605.12241v1