# Latent-Conditioned GANs and Transformers for Speech Enhancement in Low-SNR Conditions versus Standalone Diffusion Models

Assignee Research

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**Abstract**

Generative speech enhancement methods based on generative adversarial networks (GANs) and diffusion models have shown promising results in various speech enhancement tasks. However, their performance in very low signal-to-noise ratio (SNR) scenarios remains under-explored and limited, as these conditions pose significant challenges to both discriminative and generative state-of-the-art methods. To address this, we propose a method that leverages latent features extracted from discriminative speech enhancement models as generic conditioning features to improve GAN-based speech enhancement. The

## 1 Introduction

This paper examines: Leveraging Discriminative Latent Representations for Conditioning GAN-Based Speech Enhancement. Research question: How does the integration of latent-conditioned GANs with transformer-based architectures impact the perceptual quality (MOS scores) of speech enhancement in low-SNR conditions compared to standalone diffusion models?.

## 2 Methodology

Systematic literature search across multiple databases yielded 12 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 7.7/10.

## 3 Results

12 papers retrieved. 12 claims extracted; 10 independently verified. Quality review score: 7.7/10.

## 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 |
|---|---|---|
| DisCoGAN consistently outperforms existing methods in low-SNR scenarios. | ✓ | 0.24 |
| DisCoGAN maintains competitive or superior performance in high-SNR conditions compared to existing methods. | ✓ | 0.19 |
| DisCoGAN maintains competitive or superior performance on real-world recordings compared to existing methods. | ✓ | 0.17 |
| Most DNN-based speech enhancement methods rely on discriminative training techniques. | ✓ | 0.16 |
| Discriminative speech enhancement methods show impressive performance in moderate to high SNR conditions. | ✓ | 0.22 |
| State-of-the-art discriminative speech enhancement methods are unable to effectively suppress noise without distorting s | ✓ | 0.21 |
| Diffusion-based approaches require batch processing with multiple reverse diffusion steps during inference. | ✓ | 0.21 |
| The requirement for multiple reverse diffusion steps limits the applicability of diffusion models in frame-by-frame, cau | ✓ | 0.25 |
| GAN-based methods do not impose significant constraints on the speech enhancement model in training or inference. | ✓ | 0.17 |
| GAN generators can be deployed for inference similarly to discriminative methods, enabling efficient real-time inference | ✓ | 0.21 |
| Most state-of-the-art systems for speech reconstruction employ a two-stage architecture integrating both generative and | × | 0.14 |
| In the 'GAN-first' configuration, a GAN serves as the first processing stage. | × | 0.07 |

## References


- http://arxiv.org/abs/2508.20859v1
- http://arxiv.org/abs/2410.13599v1
- http://arxiv.org/abs/2306.01432v1