“Quantum - Theoretical Voice Evaluation: A Review of Emerging Perspectives and Applications”

Mette Pedersen [1]

[1]The Medical center, Østergade 18, 1100 Copenhagen

Background & Aim

Traditional acoustic analysis of the human voice often relies on classical linear models, which struggle to capture the non-linear, stochastic nature of vocal production and pathological turbulence. Recent theoretical developments, most notably: Quantum Vocal Theory of Sound, have proposed that the mathematical quantum mechanics, specifically linear operators in Hilbert spaces, offer a superior framework for describing sounds as an embodied representation. This review is of current knowledge on how quantum principles can be applied to voice evaluation and pathology detection.

Material & Methods

We conducted a systematic review of the literature (2018-2025) focusing on quantum signal processing, quantum-inspired algorithms, and vocal state superpositions. The review examines the use of quantum-mechanical postulates (observables, measurement, and time evolution) to show phonetic elements like phonation and turbulence.

Results

The literature reveals that mapping vocal signals onto a Hilbert space allows for a more nuanced representation of vocal states. Research into quantum-enhanced analysis (e.g., the QuantumMelody framework) demonstrates that hybrid quantum-classical models can activate higher agreement with expert clinical graders up to 74% in singing assessment compared to classical baselines. Quantum-inspired denoising and entanglement-based feature extraction have also shown potential in improving signal-to-noise ratios in pathological voice recordings.

Conclusions

While still in its infancy, a quantum-informed perspective on sound provides a robust mathematical toolkit for addressing complexity in phoniatrics. Future clinical applications may leverage quantum machine learning to enhance the sensitivity of automated voice grading systems, though practical implementation remains tied to advancements in quantum hardware.

Keywords

Voice, Quantum mechanics, Application.