# **Scopus**

# Documents

Amir, M.M., Asnawi, A.L., Zainal, N.A., Jusoh, A.Z.

Predicting Hypernasality Using Spectrogram Via Deep Convolutional Neural Network (DCNN) (2024) 2024 IEEE International Conference on Computing, ICOCO 2024, pp. 398-403.

DOI: 10.1109/ICOCO62848.2024.10928247

Department of Electrical and Computer Engineering International, Islamic University Malaysia, Gombak, Malaysia

### Abstract

Hypernasality, marked by excessive nasal resonance during a speech, impairs communication clarity, particularly for sounds requiring soft palate closure, such as the "f" in 'football'. Common causes include cleft lip and palate, velopharyngeal insufficiency, neurological disorders, adenoid issues, anatomical defects, and nerve system impairments. Detection and management in clinical settings are challenging due to the limited availability of speech-language pathologists (SLPs), subjective evaluation methods, and inefficient workflows. This study uses a speech feature with a deep learning model to predict the hypernasality in individuals. The objective of the study is to reduce reliance on SLPs, ensure consistent and objective evaluations, and enhance clinical efficiency. The study achieved a 92.31% accuracy in detecting hypernasality using the spectrogram features extraction method via Deep Convolutional Neural Network (DCNN). The clinical can apply this study by developing a user-friendly GUI and integrating it with a secure database. Using suitable tools for deployment, this study can be effectively applied in clinical settings. The contribution of this study is that it addresses the scarcity of SLPs and enhances clinical evaluation practices, ultimately improving communication outcomes for individuals with hypernasality. ©2024 IEEE.

## **Author Keywords**

DCNN; Deep Learning; Hypernasal; Prediction; Spectrogram

### Index Keywords

Deep neural networks, Neurophysiology, Ophthalmology, Spectrographs, Speech enhancement; Cleft lip and palates, Clinical settings, Convolutional neural network, Deep learning, Hypernasal, Neurological disorders, Soft palates, Spectrograms, Speech language pathologists, Subjective evaluations; Convolutional neural networks

# References

- Mathad, V.C., Chapman, K., Liss, J., Scherer, N., Berisha, V. Deep learning based prediction of hypernasality for clinical applications (2020) ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings, 2020, pp. 6554-6558. May, May
- Mathad, V.C., Scherer, N., Chapman, K., Liss, J.M., Berisha, V. A deep learning algorithm for objective assessment of hypernasality in children with cleft palate

(2021) IEEE Transactions on Biomedical Engineering, 68 (10), pp. 2986-2996. Oct

- Dubey, A.K., Prasanna, S.R.M., Dandapat, S. Hypernasality detection using zero-time windowing (2018) SPCOM 2018 - 12th International Conference on Signal Processing and Communications, pp. 105-109. Jul
- Zeng, Y.-T., Liu, W.-Y., Torng, P.-C., Hwu, W.-L., Lee, N.-C., Lin, C.-Y. (2021) Treating hypernasal speech in children with infantile-onset pompe disease: effectiveness of continuous positive airway pressure, Feb
- Chen, F., Yang, C., Khishe, M. Diagnose Parkinson's disease and cleft lip and palate using deep convolutional neural networks evolved by IP-based chimp optimization algorithm

6/5/25, 12:37 PM

(2022) *Biomedical Signal Processing and Control*, 77, p. 103688. Aug

- Zhang, A., Pyon, R.E., Chen, K., Lin, A.Y.
   Speech analysis of patients with cleft palate using artificial intelligence techniques: a systematic review

   (2023) FACE, 4 (3), pp. 327-337.
   Sep
- Cairns, D., Hansen, J.H.L., Riski, J.E.
   Detection of hypernasal speech using a nonlinear operator (1994) Annual International Conference of the IEEE Engineering in Medicine and Biology -Proceedings, 16, pp. 253-254.
- Lin, J., Chen, Q., Hu, J.
   Nervous System

   (2022) Color Atlas of Zebrafish Histology and Cytology, pp. 239-266.
- Gibb, A.G.
   Hypernasality (rhinolalia aperta) following tonsil and adenoid removal (1958) The Journal of Laryngology & Otology, 72 (6), pp. 433-451. Jun
- Yules, R.B., Josephson, J.B., Chase, R.A.
   A dehypernasality trainer

   (1968) Behavior Research Methods & Instrumentation, 1 (4), pp. 160-161.
   Jan
- Dalston, R.M., Warren, D.W., Dalston, E.T.
   The identification of nasal obstruction through clinical judgments of hyponasality and nasometric assessment of speech acoustics (1991) American Journal of Orthodontics and Dentofacial Orthopedics, 100 (1), pp. 59-65.
- Vijayalakshmi, P., Reddy, M.R., O'Shaughnessy, D.
   Acoustic analysis and detection of hypernasality using a group delay function (2007) *IEEE Transactions on Biomedical Engineering*, 54 (4), pp. 621-629. Apr
- Mossey, P., Catilla, E.

Global registry and database on craniofacial anomalies: report of a WHO registry meeting on craniofacial anomalies

(2001) *Human Genetics Programme Management of Noncommunicable Diseases World Health Organization Geneva*, Switzerland, Dec. Online.

- Dubey, A.K., Prasanna, S.R.M., Dandapat, S.
   Detection and assessment of hypernasality in repaired cleft palate speech using vocal tract and residual features

   (2019) The Journal Acoustic Society of America, 146 (6), pp. 4211-4223.
   Dec
- Bhattacharjee, S., Sinha, R.
   Sensitivity analysis of maskcyclegan based voice conversion for enhancing cleft lip and palate speech recognition (2022) SPCOM 2022 - IEEE International Conference on Signal Processing and Communications,
- Larangeira, F.R.
   Speech nasality and nasometry in cleft lip and palate

   (2016) Brazilian Journal of Otorhinolaryngology, 82 (3), pp. 326-333.
   May

- Demircan, S., Örnek, H.K.
   Comparison of the effects of mel coefficients and spectrogram images via deep learning in emotion classification (2020) *Traitement du Signal*, 37 (1), pp. 51-57.
- (2024) Audacity ® | Free Audio editor, recorder, music making and more!, Accessed: Sep. 17, Online.

#### **Correspondence Address**

Asnawi A.L.; Department of Electrical and Computer Engineering International, Malaysia; email: aniliza@iium.edu.my

Publisher: Institute of Electrical and Electronics Engineers Inc.

**Conference name:** 2024 IEEE International Conference on Computing, ICOCO 2024 **Conference date:** 12 December 2024 through 14 December 2024 **Conference code:** 207836

ISBN: 9798331530303 Language of Original Document: English Abbreviated Source Title: IEEE Int. Conf. Comput., ICOCO 2-s2.0-105002027826 Document Type: Conference Paper Publication Stage: Final Source: Scopus

ELSEVIER

Copyright © 2025 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

*RELX* Group<sup>™</sup>