

Title (en)

N band FM demodulation to aid cochlear hearing impaired persons

Title (de)

N-Band FM-Demodulation als Hilfe zur Hörverbesserung von Cochlea-Hörgeschädigten

Title (fr)

Démodulation FM à bandes multiples pour aider les personnes à déficience cochléaire

Publication

EP 2184929 A1 20100512 (EN)

Application

EP 09175148 A 20091105

Priority

- EP 2008065196 W 20081110
- EP 09175148 A 20091105

Abstract (en)

The invention relates to: A signal processing device comprising a signal processing unit for processing an electrical SPU-input signal comprising frequencies in the audible frequency range between a minimum frequency and a maximum frequency, and providing a processed SPU output signal. The invention further relates to its use and to a method of operating an audio processing device. The object of the present invention is to provide a scheme for improving a user's perception of an acoustic signal. The problem is solved in that an FM to AM transformation unit for transforming an FM2AM input signal originating from the SPU-input signal and comprising at least a part of the frequency range of the SPU-input signal from a frequency modulated signal to an amplitude modulated signal to provide an FM2AM output signal, which is used in the generation of the processed SPU output signal. This has the advantage of providing an improved perception by a hearing impaired user of an input sound.

IPC 8 full level

A61N 1/36 (2006.01)

CPC (source: EP)

H04R 25/35 (2013.01); **H04R 25/505** (2013.01); **H04R 2225/43** (2013.01); **H04R 2430/03** (2013.01)

Citation (applicant)

- US 7225027 B2 20070529 - ZENG FAN-GANG [US], et al
- WO 9857436 A2 19981217 - LILJERYD LARS GUSTAF [SE], et al
- WO 0191111 A1 20011129 - CODING TECHNOLOGIES SWEDEN AB [SE], et al
- WO 2007006658 A1 20070118 - OTICON AS [DK], et al
- BARNEY A; SHADLE CH; DAVIES P: "Fluid flow in a dynamic mechanical model of the vocal folds and tract. . Measurements and theory", J. ACOUST. SOC. AM., vol. 105, no. 1, 1999, pages 446 - 455
- BETSER, M.; COLLEN, P.; RICHARD, G. ET AL.: "Estimation of Frequency for AM/FM Models Using the Phase Vocoder Framework", IEEE TRANSACTIONS ON SIGNAL PROCESSING, vol. 56, no. 2, 2008, pages 505 - 517
- FRIDBERGER A, TOMO; ULFENDAHL M; BOUTET DE MONVEL J: "Imaging hair cell transduction at the speed of sound: Dynamic behavior of mammalian stereocilia", PNAS, vol. 103, 2006, pages 1918 - 1923
- GEISLER CD: "A realizable cochlear model using feedback from motile outer hair cells", HEAR RES 1993 AUG, vol. 68, no. 2, 1991, pages 253 - 62
- GHITZA O: "On the upper cutoff frequency of the auditory critical-band envelope detectors in the context of speech perception", JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, vol. 110, no. 3, 2001, pages 1628 - 1640
- HOPKINS K; MOORE BCJ: "Moderate cochlear hearing loss leads to a reduced ability to use temporal fine structure information", J ACOUST SOC AM, vol. 122, no. 2, 2007, pages 1055 - 1068
- HOPKINS K; MOORE BCJ; STONE MA: "Effects of moderate cochlear hearing loss on the ability to benefit from temporal fine structure information in speech", J ACOUST SOC AM, vol. 123, no. 2, 2008, pages 1140 - 1153
- HUDSPETH AJ: "How the ear's works work: mechano-electrical transduction and amplification by hair cells", C. R. BIOLOGIES, vol. 328, 2005, pages 155 - 162
- JOHN MS ET AL.: "Multiple auditory steady-state responses to AM and FM stimuli", AUDIOL. NERUROOTOL., vol. 6, no. 1, 2001, pages 12 - 27
- KAISER, J.F.: "On a simple algorithm to calculate the 'energy' of a signal", ICASSP, 1990
- LIBERMANN MC ET AL.: "Prestin is required for electromotility of the outer hair cell and for the cochlear amplifier", NATURE, vol. 419, 2002, pages 300 - 304
- LORENZI, C.; GILBERT, G.; CARN, H. ET AL.: "Speech perception problems of the hearing impaired reflect inability to use temporal fine structure", PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, vol. 103, no. 49, 2006, pages 18866 - 18869
- MARAGOS, P; KAISER, JF; QUATIERI, TF: "On Amplitude and Frequency Demodulation Using Energy Operators", IEEE TRANSACTIONS ON SIGNAL PROCESSING, vol. 41, no. 4, 1993, pages 1532 - 1550
- MARAGOS P; KAISER JF; QUATIERI TF: "Energy Separation in Signal Modulations with Application to Speech Analysis", IEEE TRANSACTIONS ON SIGNAL PROCESSING, vol. 41, 1993, pages 10
- MCLAUGHLIN S; MARAGOS P: "EURASIP Book Series on Signal Processing and Communications", vol. 6, 2006, HINDAWI PUBLISHING CORPORATION, article "Nonlinear methods for speech analysis and synthesis. In: Advances in Nonlinear Signal and Image Processing", pages: 103 - 136
- MILLER RL ET AL.: "Effects of acoustic trauma on the representation of the vowel /E/ in cat auditory nerve fibers", J ACOUST SOC AM, vol. 101, no. 6, 1997, pages 3602 - 3616
- MOORE BC; SKRODZKA E: "Detection of frequency modulation by hearing-impaired listeners: effects of carrier frequency", MODULATION RATE, AND ADDED AMPLITUDE MODULATION, vol. 111, 2002, pages 327 - 35
- PICTON TW; DIMITRIJEVIC A; JOHN MS: "Multiple auditory steady-state responses", ANN OTOL RHINOL LARYNGOL SUPPL., vol. 189, 2002, pages 16 - 21
- PROAKIS, J.G.; MANOLAKIS: "D.G. Digital signal processing: principles, algorithms, and applications", 1996, PRENTICE-HALL, INC.
- RABBITT RD ET AL.: "Evidence of Piezoelectric Resonance in Isolated Outer Hair Cells", BIOPHYSICAL JOURNAL, vol. 88, 2005, pages 2257 - 2265
- RU P, CHI T; SHAMMA S: "The synergy between speech production and perception", J ACOUST SOC AM, vol. 113, no. 1, 2003, pages 498 - 515
- SHADLE CH; BARNEY A; DAVIES P: "Fluid flow in a dynamic mechanical model of the vocal folds and tract. . Implications for speech production studies", J. ACOUST. SOC. AM., vol. 105, no. 1, 1999, pages 456 - 466
- SWAMINATHAN; HEINZ: "Neural coding of envelope and fine structure in noise degraded speech", ACOUSTICS 2008 INTERNATIONAL CONFERENCE, July 2008 (2008-07-01)

- TEAGER HM; TEAGER SM: "Speech Production and Speech Modeling", 1990, ACADEMIC PUBLISHERS, article "Evidence for nonlinear sound production mechanisms in the vocal tract. In", pages: 241 - 261
- WANG, Y.; KUMARESAN, R.: "Real Time Decomposition of Speech into Modulated Components", J ACOUST SOC AM, vol. 119, no. 6, 2006, pages EL68 - EL73
- FAN-GANG ZENG ET AL.: "Speech recognition with amplitude and frequency modulations", PNAS, vol. 102, no. 7, 15 February 2005 (2005-02-15), pages 2293 - 2298
- ZHOU, G.; HANSEN, J.H.L.; KAISER, J.F.: "Nonlinear Feature Based Classification of Speech Under Stress", IEEE TRANSACTIONS ON SPEECH AND AUDIO PROCESSING, vol. 9, no. 3, 2001, pages 201 - 216

Citation (search report)

- [ID] US 2003044034 A1 20030306 - ZENG FAN-GANG [US], et al
- [X] BAUER LUKAS: "Entwicklung eines abgleichfreien Audioschaltkreises als Modul eines Multinorm-single-chip-Farbfernsehers in 1,2Ém BiCMOS-Technologie", TECHNISCHE UNIVERSITÄT BERLIN - STUDIENARBEIT, 23 December 1992 (1992-12-23), Berlin, DE, pages 1 - 100, XP002567293, Retrieved from the Internet <URL:http://mikro.ee.tu-berlin.de/~bauer/Studienarbeit_Bauer.pdf> [retrieved on 20100208]

Cited by

EP2663094A1; EP2890159A1; US9130523B2; US9369102B2

Designated contracting state (EPC)

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

Designated extension state (EPC)

AL BA RS

DOCDB simple family (publication)

EP 2184929 A1 20100512; EP 2184929 B1 20130403

DOCDB simple family (application)

EP 09175148 A 20091105