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Digitalni celiļ ni telekomunikacijski sistem ï Govor s pol hitrosti ï Detektor aktivnega govora (VAD) pri kanalih za prenos govora s pol hitrosti (GSM 06.42, razliļ ica 5.0.1)

Digital cellular telecommunications system; Half rate speech; Voice Activity Detector (VAD) for half rate speech traffic channels (GSM 06.42 version 5.0.1)

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Digital cellular telecommunications system; Half rate speech; Voice Activity Detector (VAD) for half rate speech traffic channels (GSM 06.42 version 5.0.1)

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SIST ETS 300 973 E1:2003

Contents

Foreword 5

1 Scope 7

2 Normative references 7

3 Definitions, symbols and abbreviations 7
3.1 Definitions 7
3.2 Symbols 7
3.2.1 Variables 7
3.2.2 Constants 8
3.2.3 Functions 8
3.3 Abbreviations 9

4 General 9

5 Functional description 9
5.1 Overview and principles of operation 9
5.2 Algorithm description 10
5.2.1 Adaptive filtering and energy computation 11
5.2.2 ACF averaging 11
5.2.3 Predictor values computation 11
5.2.4 Spectral comparison 12
5.2.5 Information tone detection 12
5.2.6 Threshold adaptation 13
5.2.7 VAD decision 15
5.2.8 VAD hangover addition 15
5.2.9 Periodicity detection 15

6 Computational description overview 16
6.1 VAD modules 16
6.2 Pseudo-floating point arithmetic 16

Annex A (informative): VAD performance 18

Annex B (informative): Simplified block filtering operation 19

Annex C (informative): Pole frequency calculation 20

History 21

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SIST ETS 300 973 E1:2003
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SIST ETS 300 973 E1:2003

Foreword

This European Telecommunication Standard (ETS) has been produced by the Special Mobile Group (SMG) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS specifies the Voice Activity Detector (VAD) to be used in the Discontinuous Transmission (DTX) within the digital cellular telecommunications system. This ETS is part of the ETSs series covering the half rate speech traffic channels as described below:

GSM 06.02	ETS 300 966: "Digital cellular telecommunications system; Half rate speech; Half rate speech processing functions".
GSM 06.06	ETS 300 967: "Digital cellular telecommunications system; Half rate speech; ANSI-C code for the GSM half rate speech codec".
GSM 06.07	ETS 300 968: "Digital cellular telecommunications system; Half rate speech; Test sequences for the GSM half rate speech codec".
GSM 06.20	ETS 300 969: "Digital cellular telecommunications system; Half rate speech; Half rate speech transcoding".
GSM 06.21	ETS 300 970: "Digital cellular telecommunications system; Half rate speech; Substitution and muting of lost frames for half rate speech traffic channels".
GSM 06.22	ETS 300 971: "Digital cellular telecommunications system; Half rate speech; Comfort noise aspects for half rate speech traffic channels".
GSM 06.41	ETS 300 972: "Digital cellular telecommunications system; Half rate speech; Discontinuous Transmission (DTX) for half rate speech traffic channels".
GSM 06.42	**ETS 300 973: "Digital cellular telecommunications system; Half rate speech; Voice Activity Detector (VAD) for half rate speech traffic channels".**

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1 Scope

This European Telecommunication Standard (ETS) specifies the Voice Activity Detector (VAD) to be used in the Discontinuous Transmission (DTX) as described in GSM 06.41 (ETS 300 972) [4]. It also specifies the test methods to be used to verify that a VAD implementation complies with this ETS.

The requirements are mandatory on any VAD to be used either in GSM Mobile Stations (MS)s or Base Station Systems (BSS)s that utilize the half-rate GSM speech traffic channel.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

[1] GSM 01.04 (ETR 350): "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 06.20 (ETS 300 969): "Digital cellular telecommunications system; Half rate speech; Half rate speech transcoding".

[3] GSM 06.22 (ETS 300 971): "Digital cellular telecommunications system; Half rate speech; Comfort noise aspects for half rate speech traffic channels".

[4] GSM 06.41 (ETS 300 972): "Digital cellular telecommunications system; Half rate speech; Discontinuous Transmission (DTX) for half rate speech traffic channels".

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[5] GSM 06.06 (ETS 300 967): "Digital cellular telecommunications system; Half rate speech; ANSI C code for the GSM half rate speech codec".

SIST ETS 300 973 E1:2003
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[6] GSM 06.07 (ETS 300 968): "Digital cellular telecommunications system; Half rate speech; Test sequences for the GSM half rate speech codec".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

mobile environment: Any environment in which MSs may be used.

noise: The signal component resulting from acoustic environmental noise.

3.2 Symbols

For the purposes of this ETS, the following symbols apply:

3.2.1 Variables

aav1	filter predictor values, see subclause 5.2.3
acf	the ACF vector which is calculated in the speech encoder (GSM 06.20 (ETS 300 969) [2])
adaptcount	secondary hangover counter, see subclause 5.2.6
av0	averaged ACF vector, see subclause 5.2.2
av1	a previous value of av0, see subclause 5.2.2
burstcount	speech burst length counter, see subclause 5.2.7
den	denominator of left hand side of equation 8 in annex C, see subclause 5.2.5
difference	difference between consecutive values of dm, see subclause 5.2.4

SIST ETS 300 973 E1:2003

dm	spectral distortion measure, see subclause 5.2.4
hangcount	primary hangover counter, see subclause 5.2.7
lagcount	number of subframes in current frame meeting periodicity criterion, see subclause 5.2.9
lastdm	previous value of dm, see subclause 5.2.4
lags	the open loop long term predictor lags for the four speech encoder subframes (GSM 06.20 (ETS 300 969) [2].)
num	numerator of left hand side of equation 8 in annex C, see subclause 5.2.5
oldlagcount	previous value of lagcount, see subclause 5.2.9
prederr	fourth order short term prediction error, see subclause 5.2.5
ptch	Boolean flag indicating the presence of a periodic signal component, see subclause 5.2.9
pvad	energy in the current filtered signal frame, see subclause 5.2.1
rav1	autocorrelation vector obtained from av1, see subclause 5.2.3
rc	the first four unquantized reflection coefficients calculated in the speech encoder (GSM 06.20 (ETS 300 969) [2])
rvad	autocorrelation vector of the adaptive filter predictor values, see subclause 5.2.6
smallag	difference between consecutive lag values, see subclause 5.2.9
stat	Boolean flag indicating that the frequency spectrum of the input signal is stationary, see subclause 5.2.4
thvad	adaptive primary VAD threshold, see subclause 5.2.6
tone	Boolean flag indicating the presence of an information tone, see subclause 5.2.5
vadflag	Boolean VAD decision with hangover included, see subclause 5.2.8
veryoldlagcount	previous value of oldlagcount, see subclause 5.2.9
vvad	Boolean VAD decision before hangover, see subclause 5.2.7

3.2.2 Constants

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adp	number of frames of hangover for secondary VAD, see subclause 5.2.6
burstconst	minimum length of speech burst to which hangover is added, see subclause 5.2.8
dec	determines rate of decrease in adaptive threshold, see subclause 5.2.6
fac	determines steady state adaptive threshold, see subclause 5.2.6
frames	number of frames over which av0 and av1 are calculated, see subclause 5.2.2
freqth	threshold for pole frequency decision, see subclause 5.2.5
hangconst	number of frames of hangover for primary VAD, see subclause 5.2.8
inc	determines rate of increase in adaptive threshold, see subclause 5.2.6
lthresh	lag difference threshold for periodicity decision, see subclause 5.2.9
margin	determines upper limit for adaptive threshold, see subclause 5.2.6
nthresh	frame count threshold for periodicity decision, see subclause 5.2.9
plev	lower limit for adaptive threshold, see subclause 5.2.6
predth	threshold for short term prediction error, see subclause 5.2.5
pth	energy threshold, see subclause 5.2.6
thresh	decision threshold for evaluation of stat flag, subclause 5.2.4

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3.2.3 Functions

+	addition
-	subtraction
*	multiplication
/	division
| x |	absolute value of x
AND	Boolean AND
OR	Boolean OR

SIST ETS 300 973 E1:2003

b
MULT(x(i)) the product of the series x(i) for i=a to b
i=a

b
SUM(x(i)) the sum of the series x(i) for i=a to b
i=a

3.3 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

ACF	Autocorrelation Function
AFLAT	Autocorrelation Fixed point LAttice Technique
ANSI	American National Standards Institute
DTX	Discontinuous Transmission
LTP	Long Term Predictor
TX	Transmission
VAD	Voice Activity Detector

For abbreviations not given in this subclause see GSM 01.04 (ETR 350) [1].

4 General

The function of the VAD is to indicate whether each 20 ms frame produced by the speech encoder contains speech or not. The output is a Boolean flag (vadflag) which is used by the Transmit (TX) DTX handler defined in GSM 06.41 (ETS 300 972) [4].

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This ETS is organized as follows:

Clause 5 describes the principles of operation of the VAD. Clause 6 provides an overview of the computational description of the VAD. The computational details necessary for the fixed point implementation of the VAD algorithm are given in the form of an American National Standards Institute (ANSI) C program contained in GSM 06.06 (ETS 300 967) [5].

SIST ETS 300 973 E1:2003
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The verification of the VAD is based on the use of digital test sequences which are described in GSM 06.07 (ETS 300 968) [6].

The performance of the VAD algorithm is characterized by the amount of audible speech clipping it introduces and the percentage activity it indicates. The characteristics for the VAD defined in this ETS have been established by extensive testing under a wide range of operating conditions. The results are summarized in annex A.

5 Functional description

The purpose of this clause is to give the reader an understanding of the principles of operation of the VAD, whereas GSM 06.06 (ETS 300 967) [5] contains the fixed point computational description of the VAD. In the case of discrepancy between the two descriptions, the description in GSM 06.06 (ETS 300 967) [5] will prevail.

5.1 Overview and principles of operation

The function of the VAD is to distinguish between noise with speech present and noise without speech present. This is achieved by comparing the energy of a filtered version of the input signal with a threshold. The presence of speech is indicated whenever the threshold is exceeded.

The detection of speech in mobile environments is difficult due to the low speech/noise ratios which are encountered, particularly in moving vehicles. To increase the probability of detecting speech, the input signal is adaptively filtered (see subclause 5.2.1) to reduce its noise content before the voice activity decision is made (see subclause 5.2.7).