

Recommendation

ITU-T P.810 (03/2023)

SERIES P: Telephone transmission quality, telephone installations, local line networks

Methods for objective and subjective assessment of speech and video quality

Modulated noise reference unit (MNRU)

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Recommendation ITU-T P.810

Modulated noise reference unit (MNRU)

Summary

Recommendation ITU-T P.810 describes the modulated noise reference unit (MNRU), a standalone unit for introducing controlled degradations to speech signals. The MNRU has been extensively used in subjective performance evaluations of digital processes as reference conditions.

Historically, MNRU was implemented in analogue hardware. The Recommendation was subsequently complemented with the description of digital implementations of the MNRU for narrowband and wideband signals.

This revision provides the extension of digital MNRU to fullband signals, which shapes the flat Gaussian noise used in the narrowband and wideband versions with an average speech power spectrum. The introduction of the shaped noise provides a more representative degradation for super-wideband and fullband speech as it reduces the energy of the noise towards high frequencies.

A reference implementation of the algorithms is provided in the software tool library (STL), Recommendation ITU-T G.191.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T P.70	1984-10-19		11.1002/1000/5923
2.0	ITU-T P.81	1988-11-25		11.1002/1000/1768
3.0	ITU-T P.81	1993-03-12	XII	11.1002/1000/1769
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Keywords

Analogue MNRU, controlled degradation, digital MNRU, fullband MNRU, modulated noise reference unit (MNRU), P.50 MNRU, subjective performance evaluation.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Introduction

The modulated noise reference unit (MNRU) was originally devised to produce distortion subjectively similar to that produced by logarithmically companded pulse code modulation (PCM) systems. This approach was based on the views:

- 1) that network planning would require extensive subjective tests to enable evaluation of the PCM system performance over a range of compandor characteristics, at various signal levels and in combination with various other transmission impairments (e.g., loss, idle circuit noise, etc.) at various levels; and
- 2) that it would be as reliable and easier to define a reference distortion system, itself providing distortion perceptually similar to that of the PCM systems, in terms of which the performance of PCM systems could be expressed. This requires extensive subjective evaluation of the reference system when inserted in one or more simulated telephone connections but leads to the possibility of a simplified subjective evaluation of new digital processing techniques.

Since its initial release, called ITU-T P.81, various organizations (Administrations, scientific / industrial organizations), as well as the ITU-T itself, have made extensive use of the MNRU concept for evaluating the subjective performance of digital processes. For example, MNRU was used as early as in the year 1988 for Recommendation [b-ITU-T G.722], and even before since 1981 for the 32 kbit/s adaptive differential pulse code modulation (ADPCM) algorithm of Recommendation initially called [b-ITU-T G.721], which was further redeveloped and revised in [b-ITU-T G.726]. The original narrowband version (100-3 400 Hz) was subsequently extended to a wideband bandwidth (70-7 000 Hz) and then fullband (up to 20 000 Hz); the MNRU is still widely used as a reference degradation in standardization efforts such as speech codecs selection and characterization or objective quality assessment models development [b-ITU-T P-Sup.800].

Fullband MNRU, also known as P.50 MNRU, was introduced in 2008 during the development of a super-wideband objective model [ITU-T P.863]. As the modulation of a super-wideband flat Gaussian noise (50-14 000 Hz) with speech produces unnatural distortions due to the energy of the noise being too prominent towards higher frequencies, the MNRU algorithm was supplemented with a filter that shapes the Gaussian noise to an average speech spectrum derived from ITU-T P.50 test signals [ITU-T P.50]. Since P.50 MNRU was adopted as a reference degradation in the design of super-wideband and fullband speech quality subjective assessments.

MNRU was originally constructed using analogue circuitry. However, it is nowadays implemented using digital circuitry or is simulated on computers. Further information on the effects of the MNRU parameters is given in [b-Law & Seymour].

The description of the narrowband and wideband analogue MNRU remains of interest and is retained in this revision, however fullband MNRU is described as a digital implementation only.

A reference implementation of the MNRU algorithms is provided in the software tool library (STL) [ITU-T G.191].