Institut für Rundfunktechnik

Christian Hartmann
A/V-Technologien

Floriansmühlstraße 60
80939 München

Tel +49 (0) 89 | 32399-376
Fax +49 (0) 89 | 32399-415

hartmann@irt.de

Institut für Rundfunktechnik GmbH • Floriansmühlstraße 60 • 80939 München

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IRT CLC algorithm: Core Technologies Overview

1. **Loudness Range Recognition**
   CLC measures the Loudness Range continuously and in real-time and thereby gains information about the natural dynamics of the input signal. Subsequently this information will be used to optimally preserve the perceived dynamics. Other loudness processors however don't have continuous information about the Loudness Range and therefore unintentionally reduce the signal dynamics by their loudness levelling stage.

2. **Real-Time and Offline Optimization**
   CLC can be used file based or in context of real-time applications. The core algorithm is identical in both cases, but the offline application can offer even higher processing quality by smartly using the benefits of infinite signal look-ahead. Moreover, CLC's processing is very robust and can gracefully handle even problematic files, which usually tend to be damaged by other offline tools. Because of CLC's already very high real-time quality, the offline processing can be accomplished very time efficient, as needed, even without performing multiple passes. Particularly compared to other offline tools offering a Loudness Range adaption.

3. **In-File Correction**
   Whereas common loudness offline tools only offer a correction of a whole file based on its overall loudness and LRA, CLC is also capable of correcting loudness and LRA inconsistencies within the file. This is particularly useful for the processing of pre-produced contents, which show unwanted loudness mismatches. Such contents can be e.g. reports produced by journalists, which makes CLC a valuable component of effective and high-quality smart production workflows.

4. **Natural LRA Scaling**
   CLC's Loudness Range processing engine internally treats loudness levels, not peak levels, as a compressor does. This technology is called Natural LRA Scaling. Unlike conventional compression, it extensively preserves from "pumping", retains the percussive "punch" and leads to the most unobtrusive and neutral sounding LRA adaption, possible.

5. **Forward Control**
   CLC calculates the current loudness of an input signal from its history and the current signal behaviour. With this information CLC is capable of determining the signal adjustment needed in order to correct the loudness and LRA to a given target value before its effect would be measurable at the output. Thus, CLC allows an instantaneous loudness adaption. Common real-time loudness processors however measure the loudness after their signal processing stage and accordingly adapt the processing via feedback control. On the long term this also leads to a given target value, but in the consequence, inappropriately timed, audible gain changes are likely to occur with such processors.

6. **Measure-Ahead**
   Because of the average-based nature of EBU/ITU loudness measure, it can't be exactly determined at a current point in time, but it always comes a bit late. Common loudness processors therefore can't calculate a current loudness or LRA value suitable for immediate reaction. CLC however uses its Measure-Ahead technology to estimate a likely future loudness by applying a statistical process. Hence, CLC determines the current loudness parameters more exactly and applies the correct processing timely. This leads to an acoustically superior listening experience.

7. **Deferred Perception**
   CLC's Deferred Perception technology evaluates the current control conditions required by the target values with respect to their perceptibility and thereby ensures that the LRA control response can be very fast without being perceptible. On the other hand, it retards the loudness levelling when needed, based on psychoacoustic criteria: If the input signal doesn't allow gain changes without being audible, only minimal gain changes are applied by CLC.

8. **Adaptive Morphing**
   CLC reacts fast on changes in the input spectral characteristics, like a multiband compressor does. At the same time, it continuously adjusts the frequency balance of its dynamic processing, so that a flat spectral response is restored. Thus, an optimal compromise between the absence of artefacts (pumping, distortions) and the preservation of timbre can be achieved. This also allows the processing of very sensitive signals. The user isn't bothered with the difficult choice of static processing envelopes (attack, hold, release) or whether to use wide- or multiband processing.

9. **Transient Preservation**
   CLC's processing doesn't necessarily affect signal transients and therefore can be fine-tuned for the processing of percussive or sensitive signals.

10. Max LoudM/LoudS Limiting

CLC's unique Forward Measurement and Control in conjunction with its Measure-Ahead Technology allows limiting the Momentary Loudness and Short-Term Loudness to a maximum value. This functionality is available not just file based, but also during real-time operation.

11. Soft True Peak Limiting

CLC's True Peak limiter makes use of a look-ahead that runs in parallel with the loudness control, which allows an extraordinarily soft and natural sounding operation.

12. Loudness Mapping

CLC is able to preserve or proportionally correct signal passages of low loudness, which shouldn't be drastically raised in gain for technical or aesthetic reasons. CLC with its Loudness Mapping Technology provides a possibility to automatically treat such passages very thoroughly without affecting the loudness correction quality of signal passages of regular loudness.

13. Compensation

Simple loudness processors do not consider loudness deviations resulting from their own signal processing. CLC however compensates for its own signal changes and therefore better achieves the given target values. This is equivalent to a fully automated make-up gain.

14. Low Latency Monitoring

CLC offers a separate output for low latency monitoring, which can be listened to by moderators and artists. The occurring algorithmic latency is < 2ms.

15. 3D-Audio Support according to ITU-R BS.1770-4

CLC supports any loudspeaker setup covered by the ITU-R BS.1770-4 loudness standard for real-time and file based applications. This also includes the established channel setups for distribution systems like Dolby Atmos® or MPEG-H.