

# COMPLETE ACOUSTIC VOICE ASSESSMENT FOR ALL CLINICIANS

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Acoustic analysis of voice signals is especially appealing in voice clinics because of multiple reasons. First, they provide easy to understand, non-invasive, and relatively low-cost solutions for objective documentation of specific features of a patient's voice (disorder). Second, they not only provide baseline measures, but they can also be applied for follow-up and for tracking voice outcomes across time and/or intervention. Third, they can offer insights in vocal physiology and may therefore serve as one of the objective guides in voice treatment. The following acoustic markers or graphs can be considered typical examples of items in a clinical voice assessment protocol: fundamental frequency ( $F_0$ ), intensity level (IL), voice range profile (with at least highest  $F_0$ , lowest  $F_0$ , softest IL, and loudest IL), sound spectrography, and one or more markers of type and/or severity of hoarseness. There are many software programs to yield such markers. Some of the programs are commercially available (sold with or without hardware recording equipment), whereas other programs can be downloaded for free from the internet. Both options have their advantages and disadvantages. There are also many hardware options related to microphone, pre-amplifier and computer, either sold as a package or to be purchased separately. However, regardless of which combination of hardware and software, it is essential that the eventual information (either numerically or graphically) is obtained as reliable as possible and can be regarded clinically valid.

One of the free-available programs for sound signal analysis is Praat (Paul Boersma & David Weenink, Institute for Phonetic Sciences, University of Amsterdam, The Netherlands). Although originally not developed for acoustic voice analysis, it has many built-in functions to meet that purpose ( $F_0$ , IL, perturbation, spectrogram, long-term average spectrum, harmonics-to-noise ratio, etc.). However, having to do many of the analyses and having to draw the charts by hand over and over again, makes working with Praat in voice clinics less standardized, less efficient and less user-friendly compared to other programs. Implementing scripts (these are executable texts that activate menu and action commands) in the program Praat, on the other hand, enables the clinician to automate these analyses and drawings and therefore to reduce time and labour when assessing voice signals on a daily basis. Scripts have been developed to measure and/or illustrate the following aspects: speech-to-noise ratio and voice-to-noise ratio, vocal  $F_0$ , vocal IL, sound spectrography and acoustic voice markers, sound cepstrography and smoothed cepstral peak prominence, vocal range estimation, and Acoustic Voice Quality Index.

This workshop will start by discussing the importance of working with audio recordings with sufficient signal-to-noise ratio, especially for acoustic measures of voice quality. What it comes down to, is that all relevant vocalizations and speech tokens are as least as possible contaminated by recording-related noise. This implies knowledge about and choices in sound recording equipment. Once it has been shown that the audio samples have acceptable quality, for example by using the script for speech-to-noise ratio and voice-to-noise ratio, the following scripts will be (a) live demonstrated on one or more volunteers from the audience and (b) discussed in terms of relevant speech tasks, signal selection, specific voice/laryngeal pathologies, and clinical feasibility: vocal  $F_0$  and its distribution, vocal IL and its distribution, sound spectrography and acoustic voice markers (including jitter, shimmer and harmonics-to-noise ratio), sound cepstrography with quefrequency-domain markers (including the smoothed cepstral peak prominence) and a CPPS-time-plot, three-dimensional vocal range estimation with  $F_0$ -IL-coordinates coloured based on their harmonics-to-noise ratio as well as a minimum set of measures, Dysphonia Severity Index v.02.02, and Acoustic Voice Quality Index v.02.04. All these scripts can easily be implemented and coupled to a button in either the fixed or the dynamic menu's of the program Praat. Currently, acoustic assessment of voice in our clinic is accomplished completely in the program Praat through these custom-made scripts.