THE INFLUENCE OF DIFFERENT MICROPHONE SYSTEMS TO BIOMETRIC ACUSTIC MEASUREMENTS

– EXEMPLIFIED BY VOICE FREQUENCY ANALYSIS –

by

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Background of the study

Regarding acoustic biometric measurements, various parameters like speech recognition or the detection of parameters, which are relevant for health / disease, literature indicate error ratios up to 40%, depending on the use of different microphone systems. Because of the increasing use of voice analyses not only for speech recognition, but also for the evaluation of stress systems, emotional stress parameters (ESP) as well as for the assessment of personality profiling (PF) the error ratio should not exceed a limit of 5%.

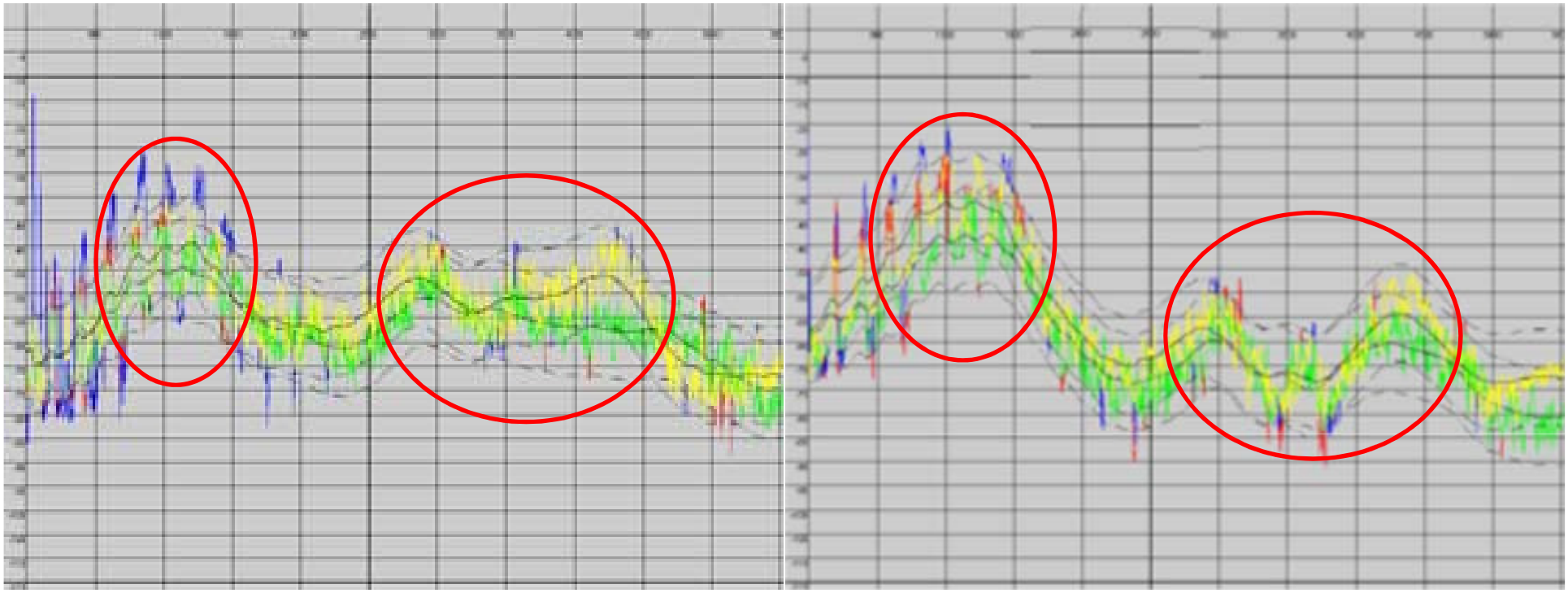

Figure 2: VFS of both vocal curves:
green –ears kept open,
yellow – ears kept shut
Left (?) reference system, right (?) test system

Objective of the study

The objective of the study is to figure out whether it is achievable to wind down the very high deviation of 40% to 5% by using special developed calibration software?

Thesis of the study

The implementation of a special software for the calibration of different microphone systems effects a reduction of the deviation of acoustic biometric measurement, ranging below 5%.

Figure 3: Test set up

Based on standardized measuring conditions in a speech lab and a recording studio, the VFA according to Heinen was used with 5 different microphone systems. The error ratio in % of sound graphs was computed with and without the application of calibration software.

System Comparison

As mentioned above, five systems were compared to the reference microphone ECM 70 ST.

1. **IMG Stage Line ECM 290, made by Monacor, Germany**
2. **Emotion AKG 550, made by AKG, Austrian**
3. **Neumann HNI 54400, made by Neumann, Germany**
4. **Pearl CR 57, made by Pearl, England**
5. **Zoom H4N, made by Zoom, made in Japan.**

Audio-System

The hardware configuration in all tests was the same. The employed device was the Asus *Eee PC 1000H* made by ASUSTeK Computer Inc, USA.

Figure 1: Voice recording of proband using two identical microphones.

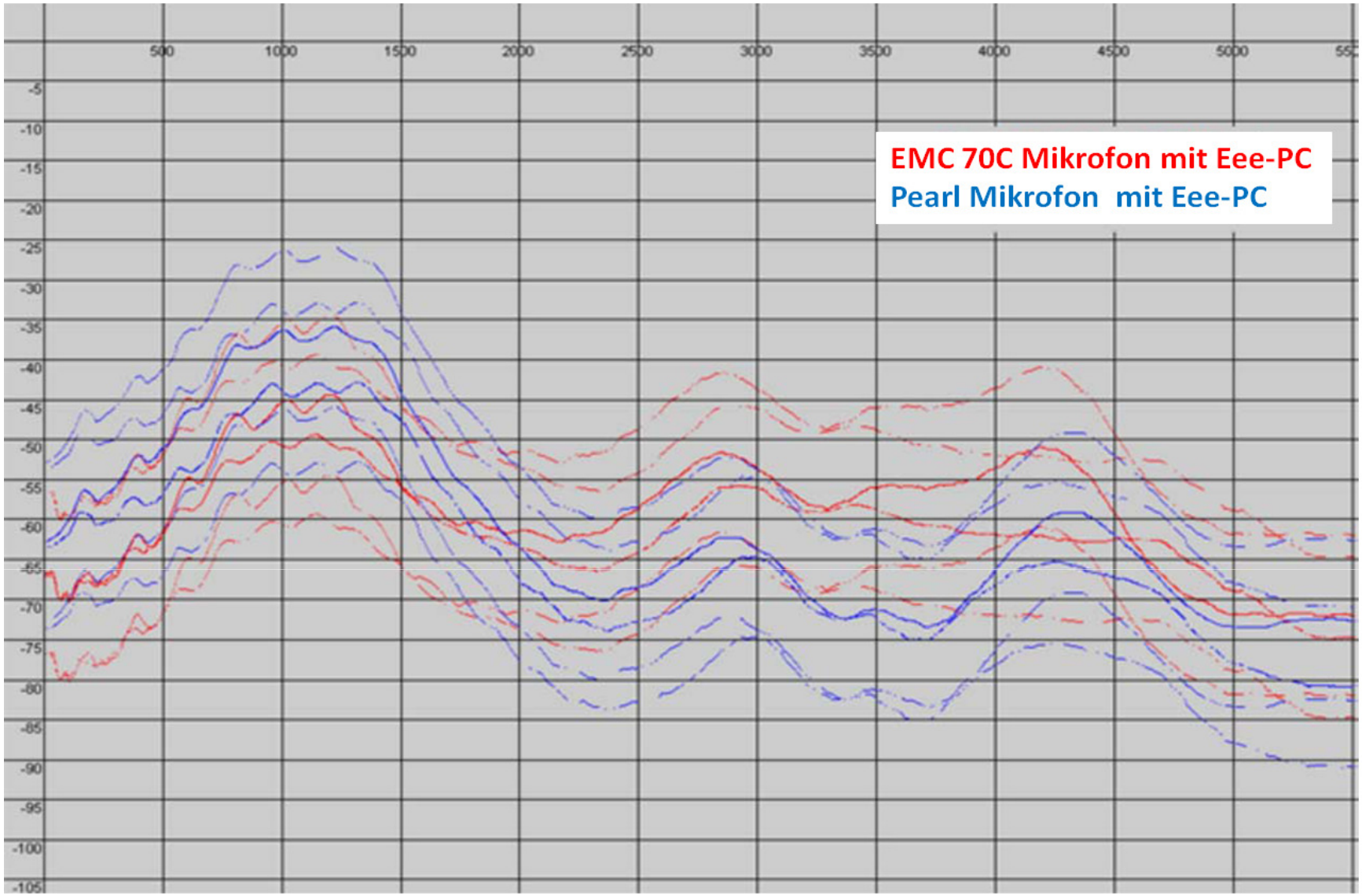

Figure 3: comparison of the mean value and the +/- 10 dB-line of the VFS of Figure 1 of the reference microphone ECM 70 ST (red) and the not calibrated Pearl-microphone (blue).

FESP/PM / Mikrofone	S/B		RE/Ox		An/Ka		ANS		Aggres-sion		Angst		Zeit		Raum	
	v	n	v	n	v	n	v	n	v	n	v	n	v	n	v	n
R	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
A	→	→	↓	→	→	→	↑↑	→	→	→	↑	→	↑↑	→	→	→
B	↓	→	→	→	→	→	→	→	→	→	↓	→	↓	→	↑	→
C	→	→	↓↓	→	↓	→	↑	→	→	→	↑↑	→	→	→	→	→
D	↓	→	→	→	→	→	↓	→	→	→	↑↑	→	↑↑	→	→	→
E	↑	→	→	→	→	→	↑	→	→	→	↓	→	↓	→	→	→

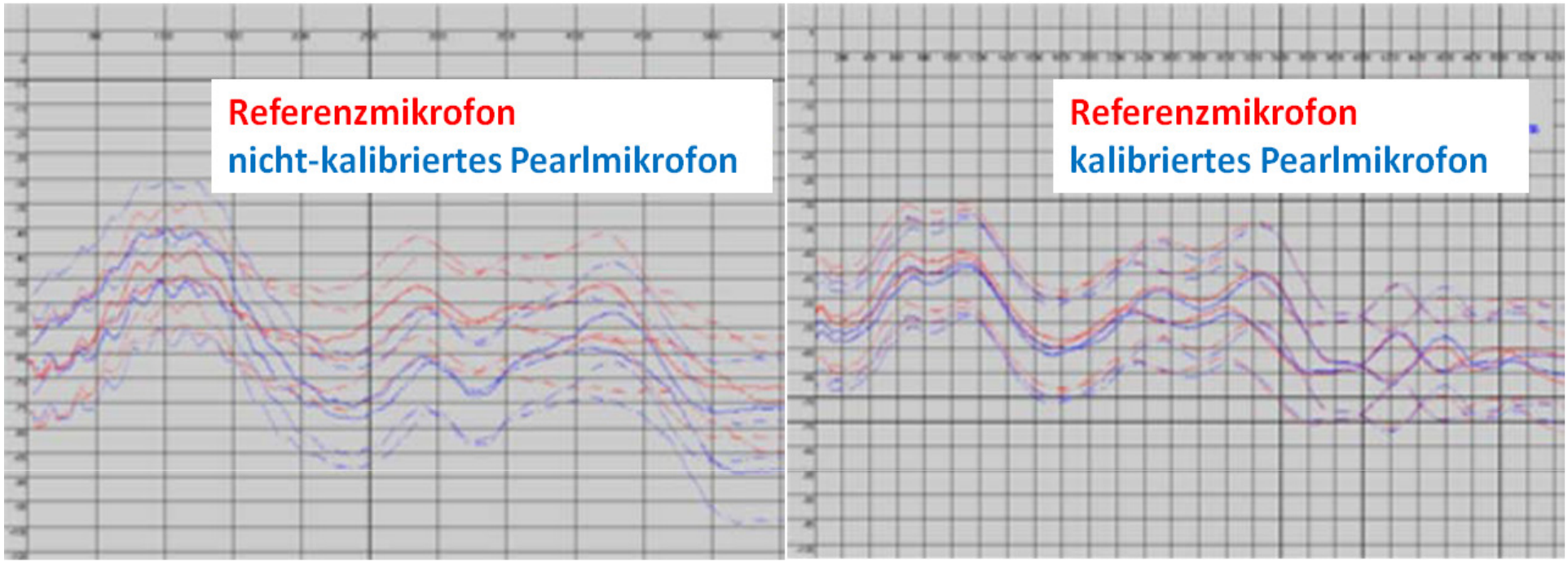

Figure 4: comparison of the mean value and the +/- 10 dB – line of the VFS of Figure 1 of the reference microphone ECM 70 ST (red) before (left) and after (right) the calibration of the Pearl-microphone (blue).

FESP/PM / Mikrofone	S/B		RE/Ox		An/Ka		ANS		Aggres-sion		Angst		Zeit		Raum	
	v	n	v	n	v	n	v	n	v	n	v	n	v	n	v	n
R	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
A	→	→	↓	→	→	→	↑↑	→	→	→	↑	→	↑↑	→	→	→
B	↓	→	→	→	→	→	→	→	→	→	↓	→	↓	→	↑	→
C	→	→	↓↓	→	↓	→	↑	→	→	→	↑↑	→	→	→	→	→
D	↓	→	→	→	→	→	↓	→	→	→	↑↑	→	↑↑	→	→	→
E	↑	→	→	→	→	→	↑	→	→	→	↓	→	↓	→	→	→

Discussion

1. As a result the study defined the error ratio of measurements with non-calibrated microphone systems was up to 40%. The calibration software reduced the ratio to below 5%.

2. From this follows that a functional-emotional medical diagnosis with freely selectable microphones may have results for the FESP and PT which differ up to 40 %. This implies a high risk of considerable misdiagnosis on essential processes of the organism. Subsequently wrong therapeutical treatments may be use which may come to substantial dysfunction and impairments of the organism. To avoid such a concatenation of incidents you only should use calibrated microphones when applying voice analysis in medical treatments.

Summery

In summary it can be said that the increasing importance of acoustic biometric measurement methods requires the calibration of microphone systems to reduce the error ratio of parameters to below 5%. This was exemplified by the VFA according to Heinen.

Thank you very much for listening to the presentation