# ELPOS

zebris

# Localisation and Repositioning of EEG electrodes
# 3D Digitization of the Shape of the Cranium


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## Introduction

When using computer-assisted analytical methods for the evaluation of EEG data, the accuracy of the positional measurement of the EEG electrodes on the patient's head has a direct influence on the consistency of the results.
ELPOS was developed in order to replace the previous complicated and mostly inaccurate methods for determining EEG electrode positions with a simple and highly precise procedure.

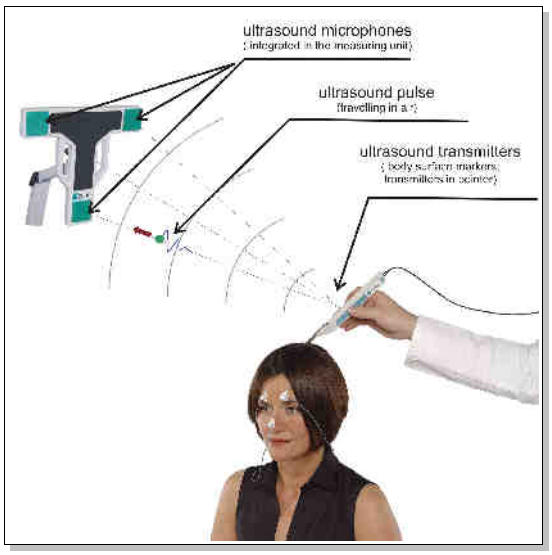
There are three main applications for ELPOS:

- **Determining the 3D coordinates of electrodes already applied to the patient's head**
- **Positioning the electrodes after specification of the exact coordinates of the measuring point**
- **Sensing the cranial shape of the patient in 3D coordinates for correlation with data from imaging methods.**

## Features of ELPOS

- Determining the 3D coordiantes of EEG electrodes within a few minutes
- Short learning curve and simple operating of the program
- The patient can move his head freely during the measurement (no fixation)
- Output of the measured points in polar coordinates in ASCII format
- Target coordinates of electrodes freely definable by entering polar coordinates
- Stored 3D coordiantes of EEG electrodes can be used for acurate repositioning of the electrodes at the same position
- Output of the graphical display of the measured position of the electrodes on a printer is possible

## Measuring principle




The system contains markers, which consist of small, sequential working ultrasonic transmitters. They can be connected to the basic unit directly. The ultrasonic pointer consists of two built in markers in known distance to each other and to the tip. The measuring unit contains three ultrasonic microphones. They are arranged in defined distances and are equipped with special electronics for evaluation.

During operation the ultrasonic markers send continuous pulses. The distance to the microphones is determined through the measurement of the running time of these pulses. By triangulation the absolut 3D coordinates are calculated.

The principle of measurement of the running time of ultrasonic pulses has compared to others the following advantages:

- Measurement of position coordinates in real time
- Insensitive for environmental disturbances like magnetical fields, noise, light, etc.
- High precision (system error for the measurement of electrode positions < 0.8mm; maximum deviation from the original position during repositioning < 1.4mm)
- Modular expandability for general tasks in 3D motion analysis

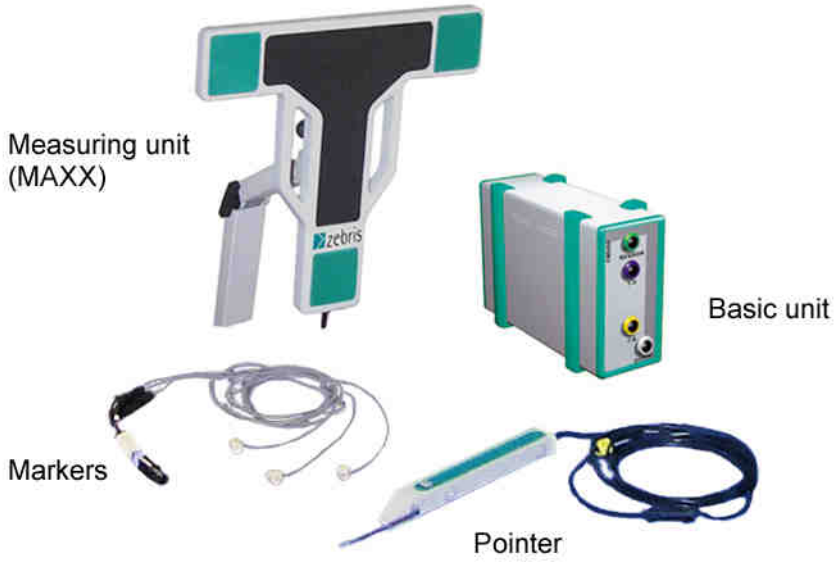
## System construction

The 3D-Digitizing System ELPOS for localisation of EEG electrodes and for scanning the head shape consists of the basic unit (CMSEP / CMS20S), the measuring unit (MAXX), the ultrasonic pointer, three single markers and the software "ElGuide".

The pointer is used for entering the electrode positions by pointing on them on the paitent´s head and pressing the button or scanning the shape of the cranium.
The three markers are attached to the patient´s head and define a fix reference coordinate system which allows the free movement of the patient´s head during the measurement.

Every microphone has its own processor for the signal processing and sending it further on to the parallel port of the PC. The cartesian 3D coordinates of the markers are calculated and displayed as polar coordinates on the PC in real time.

## Complete arrangement of measurement system




## Operation of the system

- Connect the basic unit to the printer port of the PC
- Mount the measuring unit on the floor stand (see picture)
- Connect the measuring unit to the grey socket of the basic unit (Sensor)
- Connect the ultrasonic pointer to the yellow socket of the basic unit (Marker 7-9)
- Connect the three ultrasonic reference markers via the single marker adapter to the blue socket of the basic unit (Marker 1-3)

## Preparing the patient

Attach the three reference markers to the patient´s skin via adhesive patches.

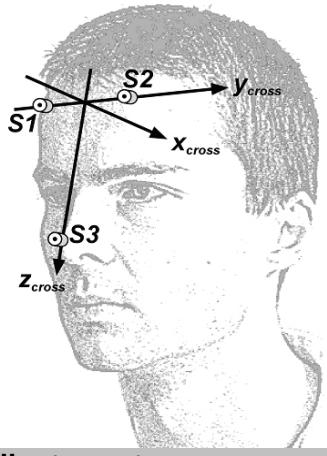
Position of the reference markers e.g.:

S1: right knob of the forehead

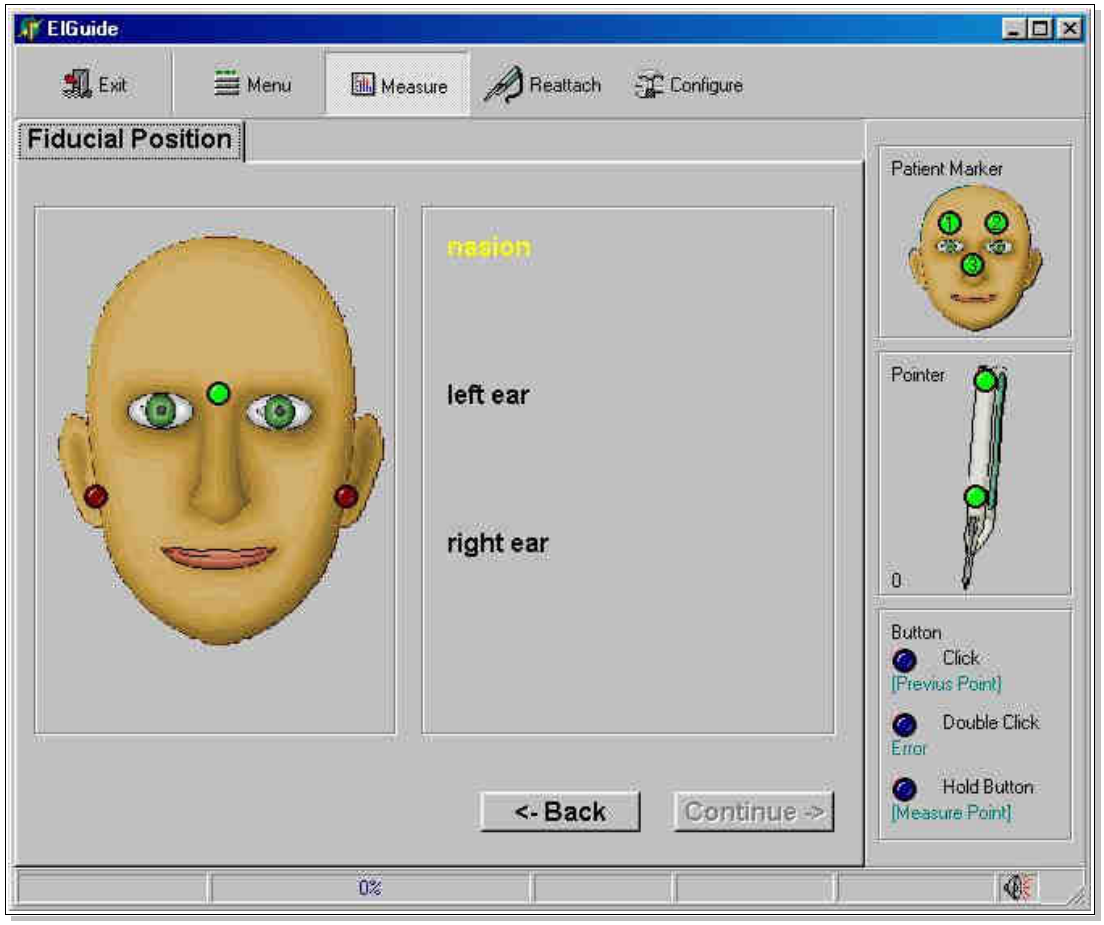
S2: left knob of the forehead

S3: tip of the nose

These markers define the *cross coordinate system* (other positions are possible).




## Definition of reference points in the cross coordinate system

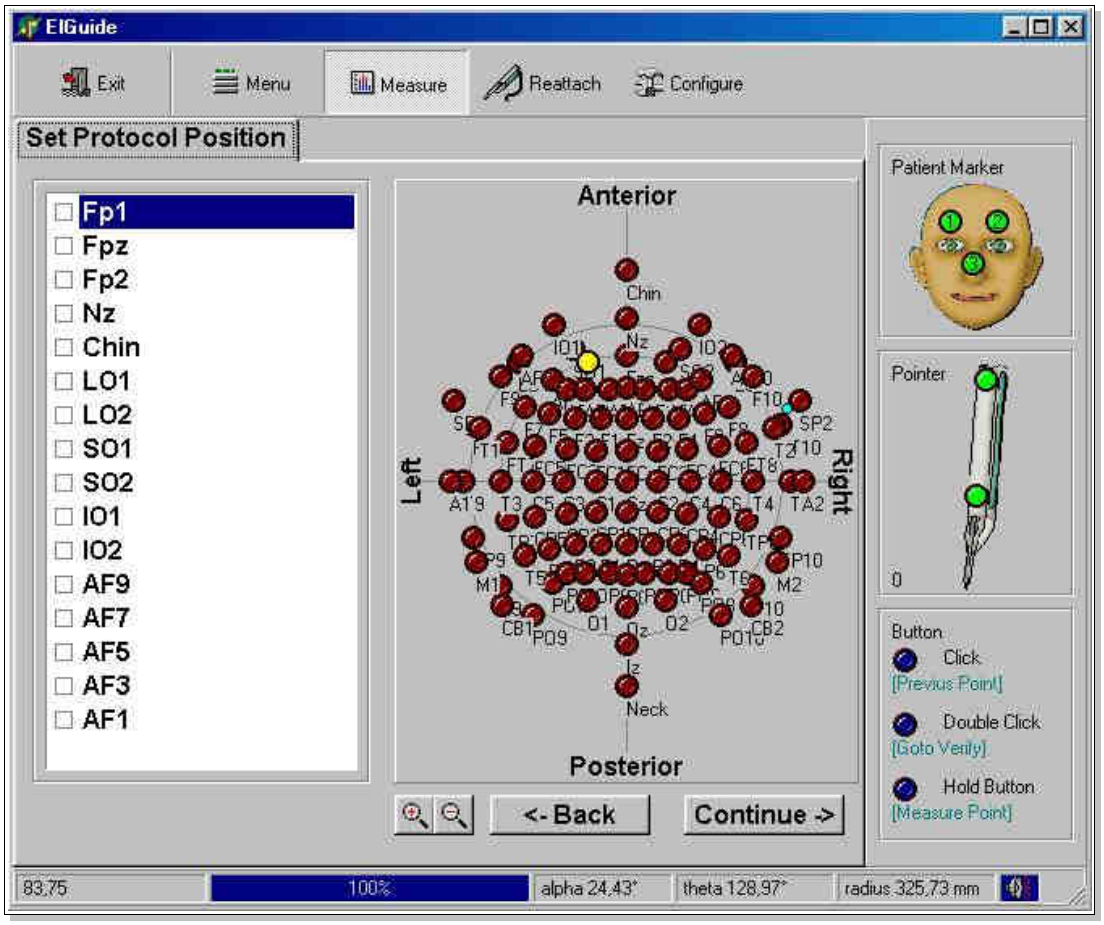



Each of the three reference points has to be entered one time with the ultrasonic pointer. The sequence is pre-defined by the program. To enter a point as reference point, the button at the ultrasonic pointer has to be pressed (acoustic feedback when point is entered).

1. Reference point: Nasion
2. Reference point: Left ear
3. Reference point: Right ear

These points define the *head coordinate system.*

## Measurement of the position of electrodes in the head coordinate system




Give electrode names, enter the electrode position with the ultrasonic pointer by pressing the button (acoustic feedback when point is entered). Repeat for all electrodes.

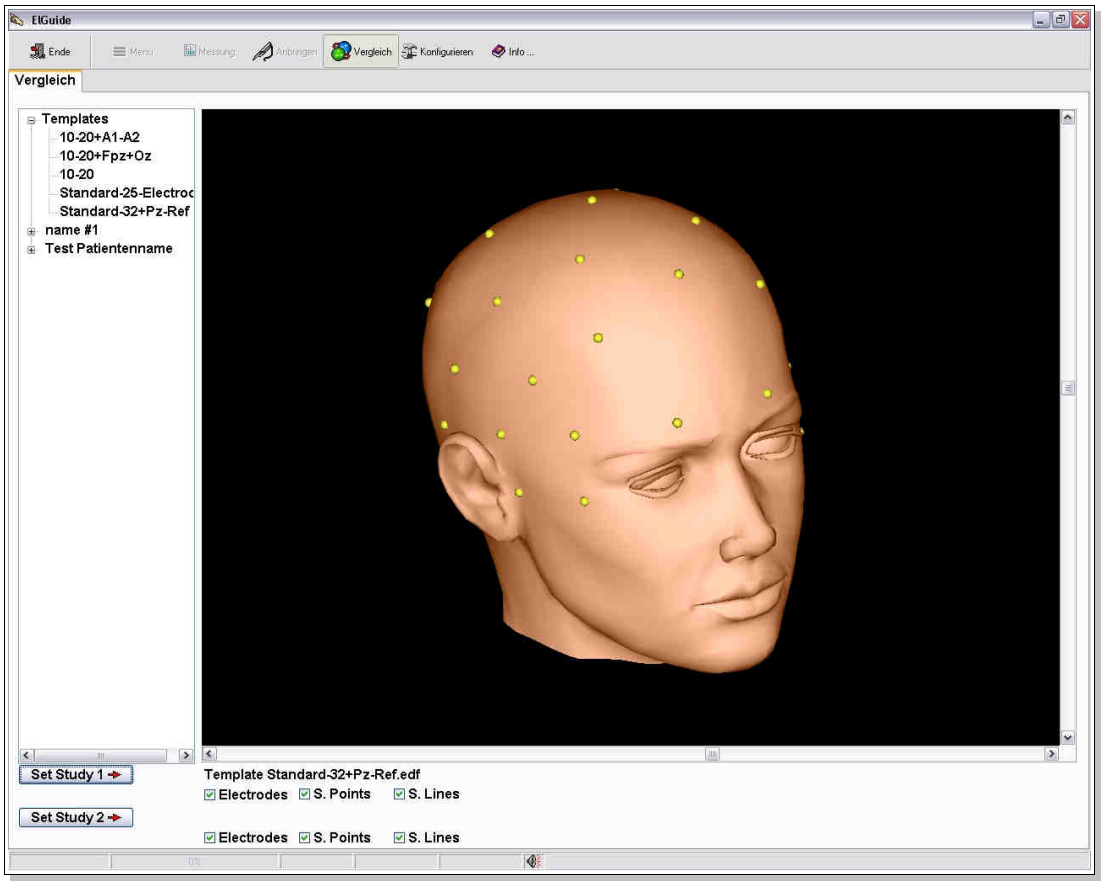
### Template repositioning of electrodes

Choose electrode from the left window. The electrode is marked yellow in the right window. Tip on a position on the patient´s head with the ultrasonic pointer (blue dot in the right window). Move the pointer according to the instructions of the program (acoustic commands and graphical display).

### Scanning the surface of the cranium

Surface scan:
Scan along the patient´s head with the pointer and hold the button pressed. Enter as many lines as you need.

Surface points:
Scan along the patient´s head with the pointer and click every single point you like to have.




## Technical Data

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|---|---|
| **Basic unit:** | |
| Dimensions: | 255 x 155 x 315 mm (W x H x D) |
| Weight: | 5.5 kg |
| **Measuring unit:** | |
| Dimensions: | 255 x 255 x 25 (W x H x D) |
| Weight: | 0.9 kg |
| Position measurement resolution: | 0.1 mm |
| Position measurement accuracy: | approx. ± 0.8 mm |
| Repositioning accuracy: | approx. ± 1.2 °(test radius 120 mm) |
| Points used for averaging during the determination of the position: | 10 |
| Max. number of points for scann of the cranial surface: | approx. 4000 |
| Elguide software: | runs under up to date Windows operating systems |