

# DEVELOPMENT OF TELLURIC RECORDING SYSTEM AT THE SZÉCHENYI ISTVÁN GEOPHYSICAL OBSERVATORY OF THE HUNGARIAN ACADEMY OF SCIENCES – IAGA DIVISION 5. OBSERVATORY, INSTRUMENTS, SURVEYS AND ANALYSES

Vilmos Gorócz<sup>1</sup>, József Szabó<sup>1</sup>, László Csurgai Horváth<sup>1</sup>, István Lempenger<sup>2</sup>,  
Dániel Piri<sup>2</sup>, Judit Szendrői<sup>2</sup>, Eszter Szűcs<sup>2</sup>, Viktor Wesztergom<sup>2</sup>

## 1 Introduction

Since 1957 the Széchenyi István Geophysical Observatory (IAGA code: NCK), Hungary, has provided continuous Earth current and geomagnetic observations. NCK lies on thick conductive sediment and is situated within a National Park, which helps reduce the effects of man-made electromagnetic noise. General analysis of the man-made ULF noise was carried out by Villante et al (2004) at several European observatories. From this analysis it was concluded that the man-made noise amplitude at NCK is orders of magnitude lower than the variations caused by natural effects, however the spectral analysis of long time data series might be influenced by working days of stronger effects and reduced weekend noise levels. Potential differences are measured between low-polarisation lead electrodes (buried at the depth of 1.5 m) in the North-South (Ex) and East-West (Ey) directions, with an electrode spacing of 500m. Potential differences are recorded at 1 sec and 10 sec sampling intervals with a voltage resolution of 6.1  $\mu$ V/km.

## 2 Description of new Telluric Amplifier and Data Logger

In frame of a general instrumental development campaign a new telluric measurement instrumentation has been developed and installed in the Observatory. The development has been performed in cooperation with the Faculty of Electrical Engineering and Informatics of the Budapest University of Technology and Economics with the intention to increase the resolution of the earth current signal recordings (24 bit A/D converter), to extend the dynamic range of the operation (10  $\mu$ V/km – 10 V/km) and to increase the sampling rate even to 3.6 kHz. For detailed description see Gorócz (2014). The data is available real-time via ftp, backup of daily binary data files is regularly saved on two separate local storages. The synchronization of the measurement data with an absolute reference time is guaranteed by a standard DCF77 module. To ensure the wide operation range each channel consist two decoupled amplifier circuit: Two amplifier channels per input are used in order to split the measurement range into two parts: one for low level signals and the another is for measuring signal components higher than 1V. For low level signals, increased CMRR (Common Mode Reject Ratio) and a 5th order filter is applied. By increasing the gain of the first amplifier, the maximum amplitude of the applicable measurement signal decreases significantly due to the input common mode signal. The common mode signals are coupled to the wires of the electrodes: electromagnetic noise above 100 kHz is eliminated by the input analogue filters that also protect the instrument from high voltage input levels. The secondary analogue channel is dedicated for measuring relative high levels (over 1 V) depending on the amplitude of the common mode noise. During the measurement the ADC is oversampling the four analogue signals. It allows applying a high order digital filter during the data process instead of implementing a high order analogue filter. By applying a high order (more than 100) filter enables to set the appropriate upper frequency. By applying the high sampling frequency the low order analogue filter is more effective, because the antialiasing effect is greatly reduced, which is especially important in the voltage range under 1 mV.

<sup>1</sup>Department of Broadband Infocommunications and Electromagnetic Theory,  
Budapest University of Technology and Economics  
E-mail: gorocz@hvt.bme.hu

<sup>2</sup>MTA CSFK Geodetic and Geophysical Institute

Given such a long continuous measurement record, the NCK data are ideal for estimating electric field extremes that could be observed at ground level due to space weather and also to characterise the long term behaviour of the geoeffective solar activity.

**Acknowledgements.** The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7 / 2007–2013) under grant agreement 260330. This study was supported by the TAMOP-4.2.2.C-11/1/KONV-2012-0015 (Earth System) project sponsored by the EU and European Social Foundation.

Development of the research infrastructure was also sponsored by the Infrastructure Development Fund of the Hungarian Academy of Sciences.

### References

- Baillie O, Thomson A, Nagy T, Dawson E, Kelly G, Wesztergom V, Clarke E** (2013): Extreme value statistics applied to geoelectric activity. European Weather Week 10, Antwerpen, 18-22nd November 2013, S1: Poster #7.
- Gorócz V** (2013): Obszervatóriumi műszer tervezése és építése tellurikus áramok méréséhez, MSc szakdolgozat, 2013. BMGE, Budapest.