

Design and Development of Passive Super Low Frequency Electromagnetic Data Processing Software¹

Rongbo Cui, Qimin Qin, Baishou Li, Qingpei Wang*

Institute of Remote Sensing and GIS, Peking University, Beijing 100871, China

*Corresponding Author: Tel: +86-10-62764430; Email: cuirongbojiyi@126.com

Abstract:

Super low frequency (SLF) electromagnetic wave (30-300Hz) can be used to detect the underground substance, because SLF electromagnetic waves are able to travel through most solid, liquid and gas. The recent research showed that passive SLF electromagnetic method can effectively explore the coal bed methane^[1] and gobs in mines^[2]. Considering dependence on natural source and weak anti-interference ability of passive SLF exploration, we need to design and develop a software which can pay attention to the raw signal analysis, improve de-noising method and strengthen data visualization. Therefore, based on the investigation of passive SLF exploration's application, the paper proposes the requirement analysis as follows:

1) Reading and transformation of the raw data from passive SLF electromagnetic exploration

Raw data from the exploration is self-defined, can not be identified and used by the most software. For the purpose of data analysis by the multi-software tools, we need to read the raw data so that it can be called by the software itself, and to transform the raw data to the format of 'txt' so that it can be used by the analysis software such as Matlab, excel and so on.

2) Visualization and analysis of the raw signals

In the passive SLF exploration, the raw data are got through calculation the maximum amplitude of eight times sample signals for each frequency. For fully studying on the properties of signals, the raw signals of passive SLF exploration should be visualized and its energy spectrum and mean should be calculated.

3) De-noising of the raw data.

The raw data are influenced by the several noises. Now the de-noising algorithms aiming at passive SLF exploration have not been developed. So the general algorithm can be considered to improve the signal-to-noise ratio.

4) Multiple dimensional display of the data curve.

In the passive SLF exploration, multiple data, that may contain different depth and step size, are always collected for one point in different time. We need add the time dimension to display the data curves based on the 2-dimensional visualization in order to comprehensively utilize the multiple data and study on time variation features of the exploration

Considering the above application demand, based on the SLF detector BD-6 invented by Peking University, we designed and developed the processing software—Passive SLF data Processing

1. This work is supported by the Hi-Tech Research and Development Program of CHINA (2006 AA06Z233), (2007AA12Z163) and Natural Science Foundation of Beijing (4082013)

and Visualization System 1.0. With visual interface of MFC of VC++6.0, we build the main platform, which realizes 2D visualization and data reading, and then design several functional module including data processing, de-noising and calculation modules. Moreover, the system has the interface with the Matlab component through COM technology. Mixed programming with VC++ with OpenGL, we add the interactive 3D technology to the system. Among these functions, according to randomness of the noise, de-noising module superposes the multiple raw data of the one point and got the mean of data to reduce noise and strength the signal. As for the function of 3D visualization, the different depth and step size of data of the one point are normalized to the same scale, and then the time of collection is viewed as the third dimension. At last data curves are been displayed as 3D images.

At present the software has been overall designed, detailed designed and programmed. The functions such as reading and transformation of raw data, 2D visualization of raw signal and de-noising, have been realized. The software has been verified through implementation on both the coal bed methane exploration in the QinShui basin of Shanxi province and the gobs exploration in the LiuDaoWan Coal Mine of Xinjiang province.

Keywords: Passive SLF electromagnetic wave exploration, software design, requirement analysis, OpenGL

References:

- [1] Qiming Qin, LiBaishou, YE Xia, ZHANG Zexun, CUI Rongbo. The Influencing Factor Analysis of Passive Source SLF Electromagnetic Exploration Experiments at Two Geothermal Wells. IAGA WG 1.2 on Electromagnetic Induction in the Earth Extended Abstract 19th Workshop Beijing, China, October 23-29, 2008, p921-927
- [2] Xia Ye, Qiming Qin, Baishou Li, Zexun Zhang, Zili Zhang. A study on using passive super low frequency electromagnetic wave to explore goaf. IGARSS 2008