Underground Azimuth Determinations Using an Adapted Wild GAK1

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ABSTRACT

Mining and tunelling projects frequently involve the construction of long tunnels whose azimuths are to be determined very accurately, particularly prior to holing. Although conventional traverse methods may be employed, generally, these cannot guarantee the accuracy required and contractual conditions may then specify that independent gyrotheodolite bearings must be obtained. To this end, and as an alternative to the hiring of one of the modern automated systems, a theodolite with a Wild GAK 1 gyro attachment may be utilised. However, this instrument is difficult to operate with confidence, and good quality results are unlikely to be obtained without the involvement of surveying operators who are well experienced in the relevant technique.

This paper describes a fully automated system which is being developed at the Camborne School of Mines (CSM), University of Exeter: it includes an electronic 'eye' attachment to the Wild GAK1 gyro instrument, specifically designed to resolve the problems associated with manual observations and the recording of gyro tape oscillation data. The device incorporates two time-data capture sensors positioned at known points within the reflected swing path of the gyro tape's image, allowing sensor passing times to be recorded and automatically processed to establish the location of the tape's centre of oscillation; from which the true north azimuth of an unknown baseline can then be calculated.

A more complete account of the entire automated system is given comprising: a description of the sensors' structure and operation, the means by which the time data is captured and recorded, a brief account of the mathematical theory for the tape zero and spun up mode oscillation models and the new time data processing algorithm. A visual basic computer programme has been written to control each stage of the automatic procedure but details of this are not included here. Also, a summary of the calculation steps for the determination of the instrument's 'error factor' and a separate azimuth determination is given. The first of these is more specifically detailed in an actual example, with matters of accuracy being discussed as the calculation proceeds.

It is not claimed that the accuracy of results obtained by the use of this modified Wild GAK1 method are in any way superior to those obtained from modern Gyromat instruments but throughout this paper, the emphasis is on the description of an automatic system which is relatively simple to operate, accurate, reliable and comparatively inexpensive. Possible improvements in design, accuracy of calculation and adaptability are presently being investigated, with some of these being discussed in section 8.

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