

X. SHEN, M. LU, S. FERNANDO, S.M. ABOURIZK. **Tunnel boring machine positioning automation in tunnel construction.** *Gerontechnology* 2012;11(2):384; doi:10.4017/gt.2012.11.02.558.00 **Purpose** Tunnel construction using a tunnel boring machine (TBM) entails precise machine positioning and guidance in the underground space. In contrast to traditional laser-based machine guidance solutions, the proposed research aims to develop an automation alternative to facilitate TBM-guidance and as-built tunnel alignment survey during tunnelling operations. **Method** A fully automated system is proposed, in which a robotic total station is employed to automate the continuous process of TBM -tracking and positioning in the 3D underground working space. ZigBee-based wireless sensor networks are applied for wireless data communication inside the tunnel. A camera is mounted on the telescope of the total station to capture online operational videos. Real-time survey data are thus acquired, processed and displayed on a tablet PC on the fly, resulting in: (i) TBM's precise coordinates in the underground space; (ii) three-axis body rotations of the TBM; (iii) tunnelling chainage progress; and (iv) line and grade deviations of the tunnel alignment^{1,2}. **Results & Discussion** For proof-of-concept, a prototype TBM-positioning automation system has been developed in-house for laboratory testing (*Figure 1*). The accuracy testing was conducted by the automation system and a specialist surveyor independently. The differences between the two sets of surveying results were less than 2mm, which sufficiently validated the high accuracy of the automation solution. In April 2012, the prototype will be field tested on a 2.4 m diameter and 1,040 m long drainage tunnel project in Edmonton, Canada.

References

1. Shen X, Lu M, Chen W. Tunnel-boring machine positioning during microtunneling operations through integrating automated data collection with real time computing. *Journal of Construction Engineering and Management* 2011;137(1):72-85; doi:10.1061/(ASCE)CO.1943-7862.0000250
2. Shen X, Lu M, Chen W. Computing three-axis orientations of a tunnel-boring machine through surveying observation points. *Journal of Computing in Civil Engineering* 2011;25(3):232-241; doi:10.1061/(ASCE)CP.1943-5487.0000087

Keywords: automation, tunnel construction, TBM, machine control and guidance

Affiliation: University of Alberta, Edmonton, AB, Canada; **E:** johnson.shen@ualberta.ca

Full paper: doi:10.4017/gt.2012.11.02.558.783



(a)



(b)

Figure 1. Prototype of the TBM positioning automation system: (a) three tracking targets mounted on a 2.4 m diameter TBM, (b) robotic Total station linked with a tablet PC and a monitor camera via wireless sensor networks