

National University of Singapore

The brains behind smarter boring

In land-scarce Singapore, subterranean spaces could be used to house MRT stations, shopping malls and more.

“The earth also serves as the foundation for many things above it,” says Dr Li Yunyue Elita (below), winner of the Young Innovator award.

An adjunct assistant professor in the Department of Civil and Environmental Engineering at National University of Singapore, the 35-year-old Chinese national is also a Mary J. Elmore New Frontiers associate professor in Data Science in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue University in the United States.

She also served as the principal investigator of the “Look-ahead Integrated Geophysical Investigation System for Singapore Tunnels” with the Land Transport Authority (LTA), supported by the National Research Foundation and the Ministry of National Development.

Last year, Dr Li’s team of five spent almost every week testing Smart BORING, a non-intrusive, non-disruptive tunnel look-ahead system.

“Our system is named Smart BORING because we are looking at boring spaces underground, and construction work is never boring!”

Boring or tunnelling creates space in land-scarce Singapore, with the most obvious results being underground expressways, malls and MRT stations.



“It frees up space above ground for recreational sites like parks.”

Utility tunnels also hide away unsightly

water pipes and electricity cables.

While tunnel boring machines (TBMs) are used to carve all this space, tunnelling works, however, can be risky in Singapore.

Different soil and rock formation

The geological structure of our country makes it possible for soil and rock formation to vary dramatically even over a 25m span. As Dr Li shares, a TBM can tunnel through soft soil to hard rock, but the parameters must be set correctly or “the TBM will under- or over-excavate”.

Furthermore, many buildings in densely-populated Singapore sit on underground piles. If the engineering team does not know where all the piles are before it moves ahead, the TBM can impact the stability of the buildings and endanger the lives of the underground workers.

Investigations must take place before TBMs can start working. In its simplest form, the traditional method involves drilling holes at the sides of the planned tunnel and inserting sensors into them. These help the engineers to predict what lies ahead.

This intrusive method can take up a lot of manpower and energy.

Smart BORING does not require drilling. The system consists of sensors as small as toothpaste tubes. They take about 30 minutes to gather seismic data for the engineers, resulting in a smaller carbon footprint and gentler impact on the environment.

Dr Li’s system is also modular. Engineers can use up to 50 sensors, depending on the extent of the tunnelling. Moreover, it is highly portable for hard-to-reach areas. Even so, Dr Li wants to further improve her invention, hoping to make the system wireless soon.