Q&A: CHENYANG LU
MELDING SOFTWARE MODELS WITH SENSOR NETWORKS COULD SAVE LIVES

ANOTHER BRIDGE FAILS: The collapse of the Skagit River Bridge, in Washington state, is another example of infrastructural weakness.

STEPHEN BRASHEAR/GETTY IMAGES

CHENYANG LU

IN RECENT YEARS, SEVERAL DISASTERS—INCLUDING bridge failures—have illustrated that it's dangerous to take infrastructure for granted. Chenyang Lu, a professor at Washington University in St. Louis, is researching the technology of "cyberphysical systems," which combine wireless sensor networks and simulations. He spoke with Steven Cherry for *IEEE Spectrum*'s "Techwise Conversations" podcast about how this technology could predict at least some failures.

Steven Cherry: What kind of sensors would you use to monitor a bridge, and how would you use the information they produce?

Chenyang Lu: Strain gauges would measure the strength of connection between joints. Fiber-optic sensors would detect deformation in the structures. Accelerometers would measure vibration. Then you can use model analysis, signal processing—essentially, you are doing pattern recognition, to detect if there are changes in the bridge that would be indicative of damage.

S.C.: As well as laboratory testing, you've also been working with collaborators to collect data on real-world structures, such as the Jindo bridge in South Korea. What's special about this bridge?

C.L.: Jindo Bridge is a relatively new bridge; it's a very large bridge. Jindo is an island in South Korea, so they are basically connecting the island with the mainland. My collaborators deployed hundreds of sensors on that bridge. They continuously monitor the vibrations of the bridge, including cases where there are typhoons and so on blowing by. The unique thing about their system is these are wireless sensor networks. This is especially meaningful to the United States, because of all of these old bridges, where you have to retrofit a monitoring system. That's why in recent years we've been working on wireless monitoring, as it's easier to deploy. For example, you can take a technology called IEEE 802.15.4 to create a mesh network with sensors running at very low power.

S.C.: One problem with sensor networks is that the amount of data they throw off can be overwhelming.

C.L.: That's why it's never enough just to put sensors in and collect a ton of data. I have certainly heard incidents where they have these brand-new bridges with a lot of sensors, and they accumulate a ton of data but don't know what to do with it. So that's why you have to have intelligence built into these systems. It's not just collecting data but also all these sophisticated model analyses that detect localized damage. Recently here, we've begun researching how to make prognoses, so that not only can you assess the current state of a bridge, you can also predict the remaining lifetime of the bridge.

These questions and answers have been edited and condensed. To read or listen to the full interview, visit http://spectrum.ieee.org/lu1113

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