

The curmudgeon's column: High-tech low tech

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When I posted to LinkedIn some time back to generate publicity for my Geophysical Society of Houston technical lunch talk on beam tomography, one of the interesting comments from a colleague at a large service company was that beam technology is “a technology with many benefits that unfortunately is commonly regarded as old school/low tech.” I loved receiving the comment because it gives me an opportunity to talk about one of my favorite business concepts that I always look to apply: high-tech low tech. “High tech” is a term for new technology that incorporates advanced features. “Low tech” is old-school technology. I'll start with an example: the story of the Nest thermostat.

The cofounders of the Nest company were Apple employees who worked on developing the iPod and iPhone. They left Apple to start the company making the Nest thermostat that eventually was bought by Google for a billion dollars. Before Nest, thermostats looked like the Honeywell in Figure 1a — cheap-looking white plastic boxes with an outdated appearance and a small display screen. They are a perfect example of low tech. The Nest thermostat has a beautiful minimalist design, smartly blending form and function. The first thing you do after you connect it with the wall wires is enter the home wireless Internet password. The thermostat then gets the outside temperature based on your location and the average historical high and low temperatures in your area. It then starts optimizing its operation based on your daily habits and the outside temperature. It uses motion sensing, so when you walk past it, the screen automatically lights up to show the temperature and time. It allows you to see the temperature in your house from your smartphone. Via machine learning from your hourly usage, it optimizes the temperature schedule in your house. The Nest thermostat is an example of high-tech low tech. It takes a simple or older technology and combines it with advanced features and functionality.

An old Silicon Valley mantra postulates that money is not in technology but in the business application of technology. That gets us back to beam technologies and smart migrations. In the same way the Nest thermostat took the old temperature-control device to a higher level, smart migrations are taking the brute-force migrations (or dumb

migrations) to a new level by incorporating advanced features. Ray tracing, which underpins beam methods, has been theoretically understood and computationally feasible since the 1960s. Ray tracing and beams are low tech. Combining beams and standard tomography into beam tomography that produces velocity models very similar to full-waveform inversion (FWI) models is high-tech low tech.

An important point to remember is that reverse time migration, FWI, and other computationally intensive methods do not create information to form a detailed image or velocity model — the information must be present in the seismic data. This is where the first high-tech feature of beam migrations enters: the seismic data are analyzed for coherent signal and distilled to a small number of beams that carry the essence of the data. After this “velocity-less” procedure is accomplished, migrating the beams with any specific velocity is a question of minutes. The second high-tech feature is to carefully synchronize migrated beams that image the same seismic structure. The mismatch between the beams is converted to corrections of the velocity field. Because beams propagate through a small tube in the earth, the velocity modifications have pinpoint accuracy and are rich in detail. Iterating fast beam migration and these velocity updates allows for automated velocity model building that conforms to seismic structures and has details akin to velocities produced by FWI in a faster and much less computationally intensive way. Why not use all the available information to improve the quality of the image and reduce the computer resources to obtain it? **!!!**

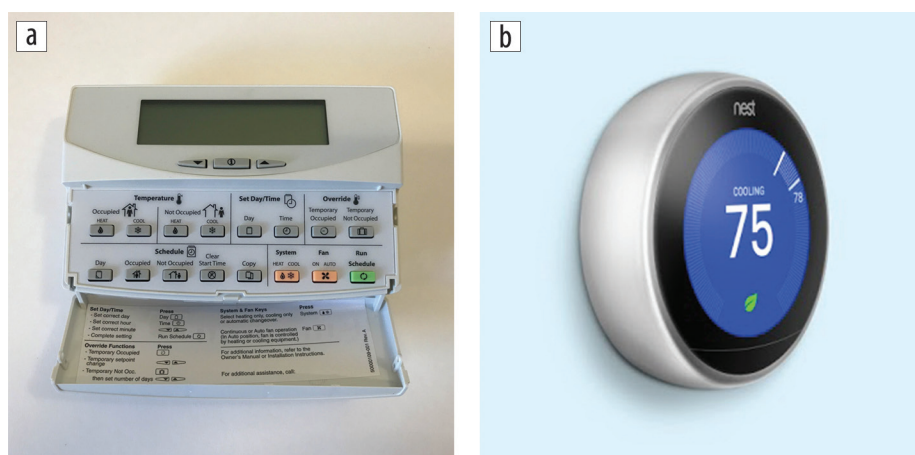


Figure 1. (a) An old Honeywell thermostat. (b) A Nest thermostat is an example of high-tech low tech.

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