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Michael Brooks reports on the big kids playing around with Lego and Tinkertoys in the name of science reports on the big kids playing around with Lego and Tinkertoys in the name of science

Jobs for the toys

Children won t be the only ones playing with toys this Christmas. Scientists, too, are finding all sorts of grownup uses for the most basic stocking fillers from measuring the speed of light using Lego bricks to simulating the human walk with a Tinkertoy.

Franco Quercioli, a researcher at the National Institute of Optics in Florence, claims all kinds of equipment can be assembled easily and cheaply from plastic Lego bricks. He has already built a range of optical kit, including microscopes and even interferometers   the most widely used instruments in optical science which measure the wavelength of a beam of light.

People tend to think that an interferometer must be built with extremely demanding tolerances, but most types can be built using Lego elements as building blocks, says Quercioli. He built his interferometer around a helium-neon laser. This is probably the most complicated system we have built thus far, and the aligning procedure was a bit more time-consuming. He claims the results are remarkably good .

After Christmas, postgraduate students at the institute will be working with Lego optics as part of their training. Not that they haven t already seen it   since his discovery, Quercioli s Lego lab has become the institute s busiest room. At first, it was difficult to convince the administration to buy the Lego, but after I succeeded, my lab was always full, says Quercioli.

The idea came to him when he went to buy a Lego Shuttle as a Christmas present last year. I bought one for my nephew and a bigger one for myself, he remembers. Taking it apart, he found that the Shuttle consisted of 120 different stud and tube components   a highly versatile system. If you think that six simple two-by-four stud bricks can be put together in roughly 100 million ways, you can easily imagine its assembling power, he enthuses. Not only that: it s lightweight, it s cheap, and it s easier to assemble than conventional optical mountings.

Since then, Quercioli has approached the Lego Company in Denmark to manufacture purpose-built optical kit. However, Lego, which has never before produced custom components, has still to commit itself. We re looking into it at the moment, and we ll come up with an answer soon, says Peter Ambeck-Madsen, senior manager at the Lego Company. He says he was not surprised by Quercioli s idea. People tend to use our elements as basic creative materials with which they do anything they want, he adds.

Meanwhile, rival toy maker, Playskool, is also in the scientific ascendant. Engineers at Cornell University in New York are about to publish the results of their work with Playskool s Tinkertoy Construction Set. The researchers have built a pair of walking legs powered only by gravity.

The legs were initially designed as a non-working model to demonstrate the way a leg hangs and moves. However, when the team started playing with the model they found it could take a few steps.

Tinkering with the distribution of weight on the legs, they found it was capable of graceful, stable, human-like walking down a shallow slope.

This could be Playskool s first citation in a scientific journal, but the research has more serious implications. Conventional wisdom dictates that the brain tells the legs what to do, but the Cornell team s results suggest that much of our ability to walk rests with the way that the weight of our legs is distributed. An understanding of how the legs swing naturally could lead to better artificial limbs, they claim.

The trouble with brain-controlled walking is that it is almost impossible to simulate. No one really knows what strategy the brain uses to fire individual muscles to produce walking, says Mariano Garcia, a member of the research team. It s possible to artificially stimulate muscles in paralysed people to let them walk, but it s pretty clumsy, and it only works for a few steps. Garcia claims doctors may one day be able to help poor walkers with the aid of a computer program and a few weights attached to their legs. It s unrealistic, maybe, but it s certainly uncharted territory, he observes.

One of the Tinkertoy model s drawbacks is that it is unable to stand when it s not moving, even if the legs are splayed. Although the project began with computer simulations of human gait, these mathematical and computational models can t explain the way the toy behaves the simple interaction of forces, driven largely by gravity, results in motion patterns too complex to simulate. It s not a problem, say the researchers, it just proves that nature has harnessed the best possible design technique.

This simplistic approach may also hold the key to producing better mobile robots; currently they tend to rely on complex control mechanisms to produce a walking motion. Robot legs built with the right weight distribution, however, might need only the simplest of command instructions to walk normally. C3PO, eat your heart out.

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