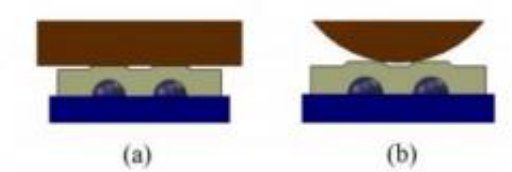
Robotics team finds artificial fingerprints improve tactile abilities

September 21 2011, by Bob Yirka



Schematic of the indentation process. (a) Flat surface being applied to the ridged skin cover. (b) Curved surface being applied to the ridged skin cover. Image credit: DOI:10.3390/s110908626

(PhysOrg.com) -- Over the past couple of decades, many people in and out of the science community have watched the steady progress being made in robotics. It's an exceptionally interesting field due to the anthropomorphic nature of the results. Each new step brings such machines closer to emulating us even as we look forward to the next step. One interesting thing about robotics is that certain areas seem to be advancing faster than others. Robot arms for example are old news, new research is focused more on hand movements. And has advances in hand movements have been made, more research has come to focus on finger movements and finally tactile sensations. Now new work by a trio of researches from the National University of Singapore describe in their paper published on the preprint server *arXiv*, how affixing artificial fingerprints to robot fingers can increase tactile "sensation" allowing such a robot to discern the differences in curvature of objects.

As with many areas of science, even the seemingly simple stuff turns out to be quite complicated on closer view. The human fingertip for example, covered with skin unlike that of any other body part, has raised ridges that allow people to feel the difference in texture between wood and metal or silk and linen. It can also detect temperature, and as it turns out, is also involved in figuring out the curvature of objects that are touched. Consider for example, the keys on a cell phone, or a television remote control. It's these kinds of abilities that Saba Salehi, John-John Cabibihan and Shuzhi Sam Ge are trying to emulate in their lab in Singapore. To begin, they've started with the easiest of the bunch, trying to figure out if artificial fingerprints fitted on a robot hand can tell how roundish an object is.

To find out they built a touch sensor comprised of a base plate, embedded sensors and a raised ridged surface; all on a 4mm square. They then set about testing the simple sensor in a variety ways to see if they were able to sense things with it in different ways, specifically as it was applied to flat, edged and curved objects. They also built an identical sensor except that the raised portion was flat instead of ridged, to serve as a control.

They found that the raised sensor did indeed provide more feedback (resonance) information than the one with the flat surface, so much so that they were able to tell the difference in the three types of objects with 95.7% accuracy.

Undoubtedly, more research will be done in this area by this group and others, and perhaps very soon, robot fingertips will become just as sensitive, if not more, than our own, leading to a whole new generation of gentler robots, able to perform tasks with both dexterity and a deft touch.

More information: Artificial Skin Ridges Enhance Local Tactile

Shape Discrimination, Saba Salehi, John-John Cabibihan, Shuzhi Sam Ge, arXiv:1109.3688v1 [physics.med-ph] DOI:10.3390/s110908626

Abstract

One of the fundamental requirements for an artificial hand to successfully grasp and manipulate an object is to be able to distinguish different objects' shapes and, more specifically, the objects' surface curvatures. In this study, we investigate the possibility of enhancing the curvature detection of embedded tactile sensors by proposing a ridged fingertip structure, simulating human fingerprints. In addition, a curvature detection approach based on machine learning methods is proposed to provide the embedded sensors with the ability to discriminate the surface curvature of different objects. For this purpose, a set of experiments were carried out to collect tactile signals from a 2 times 2 tactile sensor array, then the signals were processed and used for learning algorithms. To achieve the best possible performance for our machine learning approach, three different learning algorithms of Na"ive Bayes (NB), Artificial Neural Networks (ANN), and Support Vector Machines (SVM) were implemented and compared for various parameters. Finally, the most accurate method was selected to evaluate the proposed skin structure in recognition of three different curvatures. The results showed an accuracy rate of 97.5% in surface curvature discrimination.

via ArXiv Blog