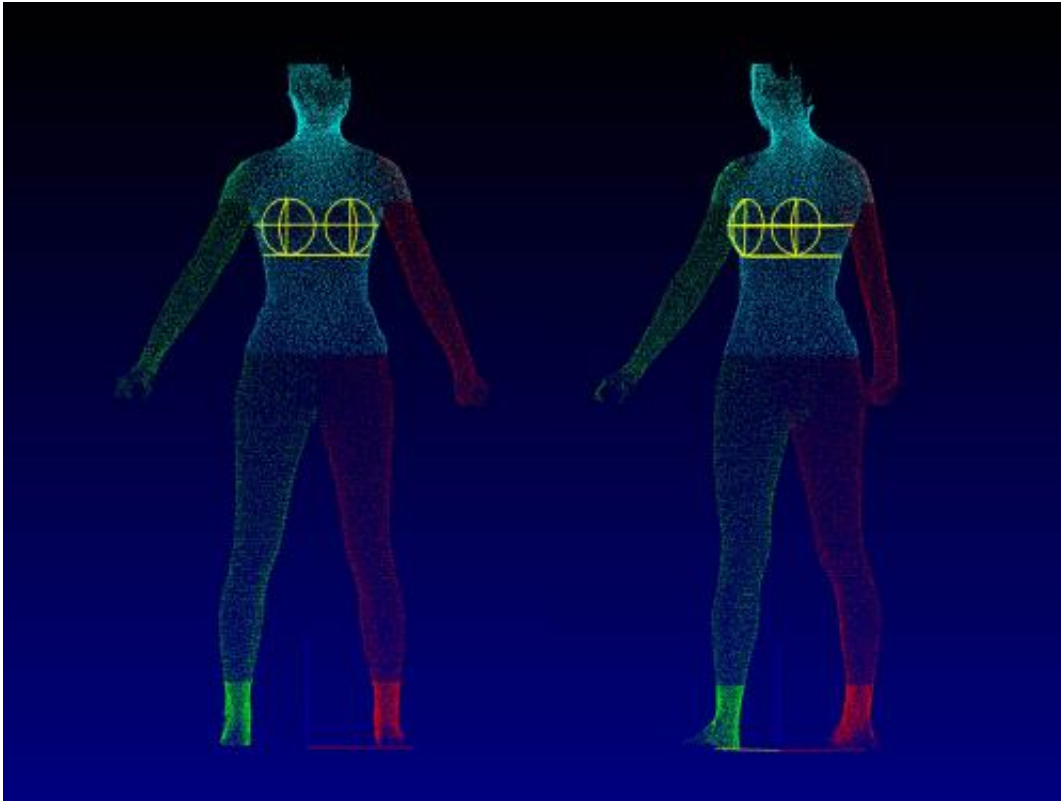


# Building a better sports bra

December 3 2013, by Stephanie Jacques

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The 3D body scan with breast measurements highlighted.

One of the most important articles of clothing in women's wardrobes and its contents are receiving a Kansas State University researcher's undivided attention.

Minyoung Suh, assistant professor of apparel, textiles and interior design, is researching the [movement](#) of [breast tissue](#) to develop a better

supportive [sports bra](#).

"Even though two bras may be the same size, the space inside the cup may be different depending on the design or the composition of the bra," Suh said. "Ideally the bra should be customized to every woman's shape and size. That's difficult commercially, but we are trying to make it as close as possible."

Many large-breasted women have a difficult time exercising or may not even try, Suh said. Developing a better sports bra may help eliminate women's hesitations to exercise based on fears, pain or embarrassment of breast movement.

"A breast is not a solid-ridged object; it moves everywhere," Suh said. "By designing the sports bra differently we can control movement. Up and down is the most movement, but there also is in and out, and side to side."

According to Suh, current sports bras are constrictive because they hold the breast tissue in toward the body and restrict movement. The tightness around the torso can be uncomfortable and may not be the best strategy for large-breasted women.

"Most of the support provided should be to lift the breast up," Suh said. "My research reveals that sports bras provide a lot of [pressure](#) inward, which constricts the torso rather than supports upward. Shoulder straps function to lift the breast up, but pressure from the strap—especially a thin strap—could be another source of discomfort."

Suh is using a 3-D body scanner to measure volume of breasts; a motion capture system to track movement of tissue; and pressure sensor system to measure the user's degree of uncomfortableness.

"We have to figure out what would be the optimum ratio of support versus pressure and how that differs in the resting position versus lifting, running and other conditions," Suh said. "Of course this is dependent on differences of individuals and ages."

The 3-D body scanner evaluates individual differences in shape and size. It is equipped with 16 cameras front and back to capture and import noninvasive images as a point cloud figure into computer software. The images enable Suh to separate the breast tissue from the rib cage and calculate the breast volume to estimate breast mass and a very accurate cup size.

Suh is using the [motion capture](#) system to study the breast tissue's direction of force when a woman exercises. Reflective markers are placed on the body and eight optical cameras in the ceiling track the sensors' movements. This helps Suh understand what direction of movement she needs to focus on the most.

"When participants are running on the treadmill or jumping, the cameras track how much the markers move," Suh said. "The computer combines all the data to make a 3-D view with XYZ coordinates and we try to calculate speed, acceleration and angles in movement."

After analyzing the direction of the force and breast movement, Suh will evaluate the role of the shoulder strap as an important part of the bra in providing antigravity support without too much pressure on the shoulders. The pressure sensor system on the shoulder provides some critical information to measure the pressure-support ratio.

"I think the wider the strap, the better," Suh said. "The same weight and the same force will be applied over the shoulder, but if we increase the area, pressure goes down. We feel the pressure, not the entire force."

Once Suh is finished calculating [breast](#) volume, movement and pressure, she will research the comfort and functional aspects of designing a bra that will support breasts effectively.

"I think the direction we are heading is to develop or engineer a sports bra to provide the optimum support in the right direction," Suh said.

Provided by Kansas State University

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