A handful of photos yields a mouthful of (digital) teeth

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Credit: Disney Research

A Disney Research team has developed a model-based method of realistically reconstructing teeth for digital actors and for medical applications using just a few, non-invasive photos or a short smartphone video of the mouth.

This new method can digitally reconstruct teeth even though some teeth are obscured in the photos or videos by the edges of the mouth or by other teeth.

"Image-based reconstructions of the human face have grown increasingly sophisticated and digital humans have become ubiquitous in everyday life," said Markus Gross, vice president for Disney Research. "By combining creativity and innovation, this research continues Disney's rich legacy of leveraging technology to enhance the tools and

systems used to create more realistic and believable digital actors for films or video games."

The researchers - from Disney Research, ETH Zurich and the Max Planck Institute for Informatics - will present the new method for teeth reconstruction at the ACM SIGGRAPH Conference on Computer Graphics and Interactive Techniques in Asia, taking place in Macao Dec. 5-8.

According to Thabo Beeler, a Disney research scientist, camera-based reconstructions have been problematic as what makes pearly whites pearly also makes them hard to capture in images—their translucent enamel and the diffuse underlying dentine. It's also difficult to get people to open their mouths wide enough to provide cameras with an unobstructed view.

"On the upside, teeth are rigid and their shape variation from person to person is manageable," Beeler said, "and as such teeth render themselves well to statistical modeling."

To create their method, the researchers first constructed a model of human teeth rows, using high-resolution 3D scans of 86 different teeth rows from the field of human dentistry.

From this training data, a model of an average tooth row was created and natural variations in shape and spacing were calculated for each tooth.

Though imaging teeth in great detail is technically difficult, the researchers developed a way to recognize their edges - where teeth meet each other, meet the gums and meet the lips. With these outlines, obtained from several photos from different angles of a person's mouth in a natural pose or from video taken while moving a smartphone from side to side, the model can be fitted to the person's teeth.

In this way, the entire tooth row - including teeth entirely blocked from view of the camera - can be reconstructed from the model.

In a final step, natural coloring of the person's teeth can be overlaid on the teeth reconstruction, providing a realistic looking set of teeth.

"Our algorithm only requires minimal user interaction and can operate on a set of individual, non-calibrated images, making teeth capture as easy and convenient as taking a few pictures or even a short video clip from a standard mobile phone," Beeler said.

More information: "Model-Based Teeth Reconstruction-Paper" [PDF, 67.15 MB]

Provided by Disney Research