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# AI study reveals the tongue's unique surface

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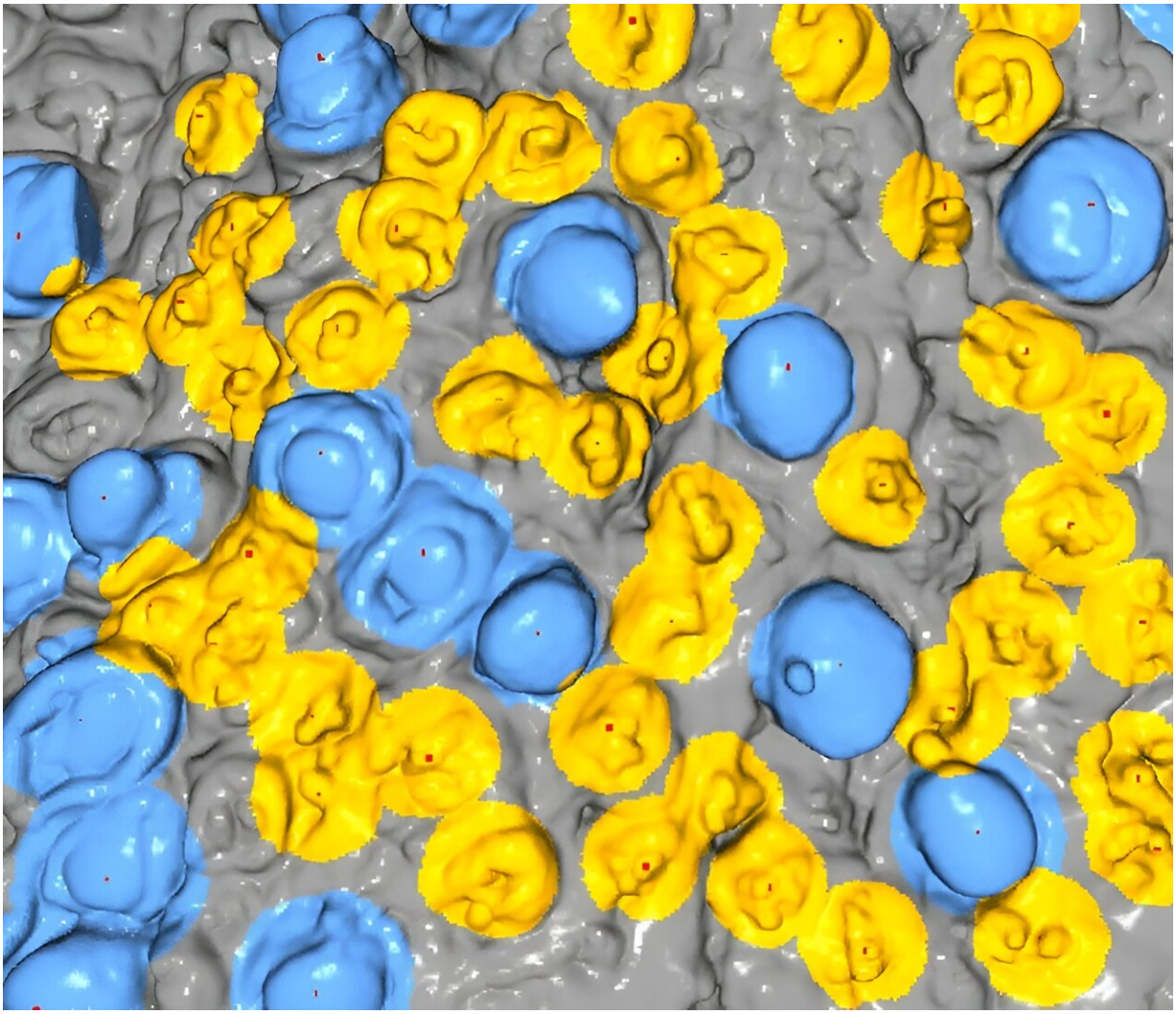

Automatic identification of tongue papillae. Illustration of the result of our tool for positioning papillae on the surface of the human tongue. Here our tool has detected the positions of fungiform (in blue) and filiform (in yellow) on the tongue surface. It has found 14 fungiform and 40 filiform papillae. As a red dot we see the center of the papillae, which is determined as the local maxima for

the structure with the highest distance from a fitted plane, using the RANSAC algorithm. Credit: *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46535-9

Artificial intelligence (AI) and 3D images of the human tongue have revealed that the surface of our tongues are unique to each of us, new findings suggest. The results offer an unprecedented insight into the biological make-up of our tongue's surface and how our sense of taste and touch differ from person to person.

The research has huge potential for discovering individual food preferences, developing healthy food alternatives and early diagnosis of oral cancers in the future, experts say. The findings have been published in the journal *Scientific Reports*.

## Tongue's functions

The human tongue is a highly sophisticated and complex organ. Its surface is made up of hundreds of small buds—known as papillae—that assist with taste, talking and swallowing.

Of these numerous projections, the mushroom-shaped fungiform papillae hold our taste buds whereas the crown-shaped filiform papillae give the tongue its texture and sense of touch.

The taste function of our fungiform papillae has been well researched but little is known about the difference in shape, size and pattern of both forms of papillae between individuals.

## Al learning

A team of researchers led by the University of Edinburgh's School of

Informatics, in collaboration with the University of Leeds, trained AI computer models to learn from three-dimensional microscopic scans of the human tongue, showing the unique features of papillae.

They fed the data from more than 2,000 detailed scans of individual papillae—taken from silicone molds of 15 people's tongues—to the AI tool.

The AI models were designed to gain a better understanding of individual features of the participant's papillae and to predict the age and gender of each volunteer.

The team used small volumes of data to train the AI models about the different features of the papillae, combined with a significant use of topology—an area of mathematics which studies how certain spaces are structured and connected.

## Remarkable accuracy

This enabled the AI tool to predict the type of papillae to within 85% accuracy and to map the position of filiform and fungiform papillae on the tongue's surface.

Remarkably, the papillae were also found to be distinctive across all 15 subjects and individuals could be identified with an accuracy of 48% from a single papilla.

"This study brings us closer to understanding the complex architecture of tongue surfaces. We were surprised to see how unique these micron-sized features are to each individual. Imagine being able to design personalized food customized to the conditions of specific people and vulnerable populations and thus ensure they can get proper nutrition while enjoying their food.

"We are now planning to use this technique combining AI with geometry and topology to identify micron-sized features in other biological surfaces. This can help in early detection and diagnosis of unusual growths in human tissues," says senior author, Professor Rik Sakar.

"It was remarkable that the features based on topology worked so well for most types of analysis, and they were the most distinctive across individuals. This needs further study not only for the papillae, but also for other kinds of biological surfaces and medical conditions," says lead author Rayna Andreeva.

**More information:** Rayna Andreeva et al, Machine learning and topological data analysis identify unique features of human papillae in 3D scans, *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46535-9

Provided by University of Edinburgh