

Press Release

Shiseido Develops “4D-Digital Skin” (Electronic Skin), Finally Reconstructing Skin Movement on Computer

- Novel skin analysis technology opens the door to another dimension -

Shiseido Company, Limited (“Shiseido”) has developed an innovative skin analysis technology called “4D-digital skin” in collaboration with Kyoichi Matsuzaki, Chief of External Plastic Surgery, Faculty of Medicine at the International University of Health and Welfare, together with researchers at Jichi Medical University and the National Institute for Physiological Sciences. This ground-breaking technology not only visualizes the skin’s internal structures in three dimensions (3D) at ultra—high resolution, but also follows the movements of all these structures during deformation of the skin, so that skin dynamics can be analyzed in detail on computer. With this technology, the causes of wrinkles and sagging can be identified, providing a rational basis for developing novel cosmetic solutions. Some of these research results were presented at the 31st IFSCC Congress 2020 Yokohama (The Virtual Congress) held from October 21 to 30, 2020*1. At this Congress, Shiseido’s presenter, Tomonobu Ezure, Ph.D., received the top award, completing an unprecedented four consecutive Congress award wins by Dr. Ezure.

This research is based on the “Inside/Outside” approach according to Shiseido’s unique R&D philosophy of “DYNAMIC HARMONY”. In this approach, we focus on the skin from both the inside (using the “4D-digital skin” technology) and the outside (using proprietary facial morphology analysis technology). By combining these different perspectives, we can achieve a global understanding of facial aging, enabling us to create innovative anti-aging products and treatments.

*1 IFSCC: The International Federation of Societies of Cosmetic Chemists

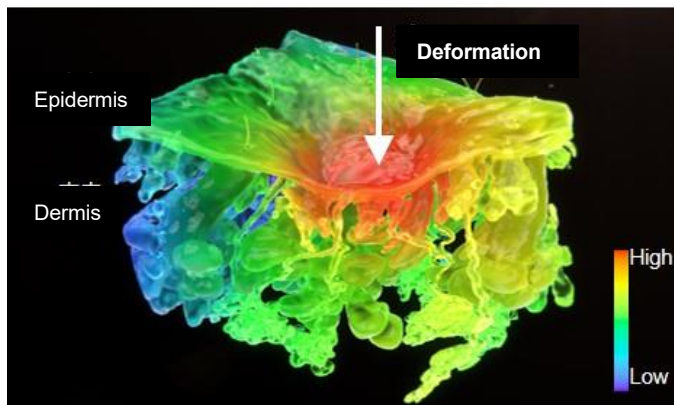


Figure 1: “4D-digital skin”

This is digitally reconstructed skin on computer, showing the structures and their movement. In this image, the amount of deformation of each structure is indicated by a color map. (This is real data, not a computer graphics image).

What are the fundamental properties of skin?

The skin is constantly being deformed by gravity and facial expressions, and flexibly recovers from these deformations. With aging, the recovery is impaired, leading to wrinkles and sagging (aged appearance). Therefore, to develop rational anti-aging solutions, it is important to shed light on skin dynamics; in other words, to understand skin movement and its mechanism under such deformation.

Recently, this research team was the first to develop a technology to analyze “static” skin in three dimensions at ultrahigh resolution, which we called “digital-3D skin”. Based on the accumulation of knowledge through this development of digital-3D skin, the team set out to develop new technology to clarify skin movement.

Digital reconstruction of skin movement on computer

First, the research team applied various deformations (compression, bending, stretching, etc.) to skin samples and observed the movements of the internal skin structures in three dimensions using X-ray CT. Next, the team used artificial intelligence (AI) to identify each of the skin structures in the huge amount of image data and to trace how each structure moved during skin deformation. Then, the information on the identity and movement of each skin structure was digitally reconstructed on a computer to create electronic skin. The team designated this electronic skin “4D-digital skin” (Figure 1).

Intuitive understanding of complex skin movements

This “4D-digital skin” can be manipulated on computer and pictures the movements of the skin components at ultrahigh resolution in color. Since the skin is digitally created, it can be freely cut on computer (digital anatomy) (Figure 2), and specific structures can be isolated (digital sorting) (Figure 3). Furthermore, the deformation amount can be quantified, and the deformation direction can be indicated with an arrow for analysis (Figure 4). Thus, “4D-digital skin” enables researchers to easily analyze the complex skin structures and their movements and intuitively understand them.

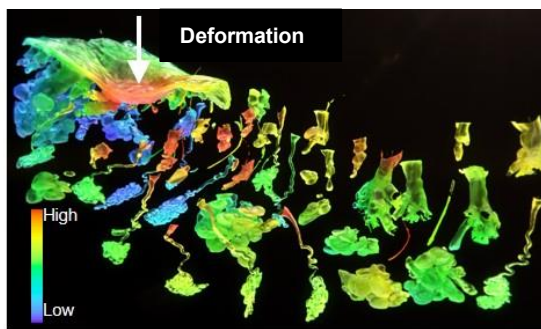


Figure 2: Digital anatomy

A novel approach to skin analysis by cutting and separating the skin on computer.

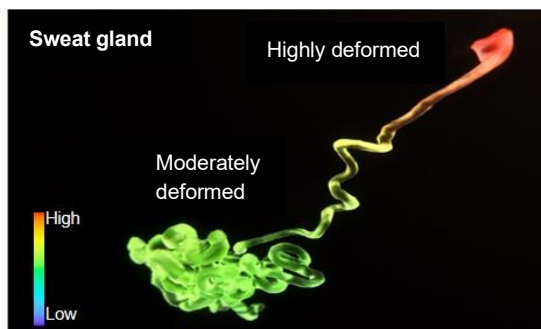


Figure 3: Ultrahigh resolution analysis of skin movement

An example of a sweat gland digitally isolated from deformed skin. The microstructure of the sweat gland and the deformation amounts within the structure are visualized in detail.

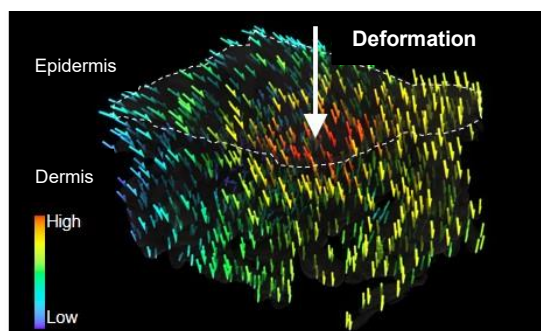


Figure 4: Analysis of deformation direction

The direction of deformation of each structure is indicated by arrows, and the deformation amount is indicated with colors, enabling researchers to intuitively understand the complex movements.

Opening the door to a new era of skin analysis

The development of “4D-digital skin” has dramatically expanded research targets and made it possible to understand the real dynamics of skin movements. With this technology, the fundamental causes of wrinkles and sagging can be identified. This in turn provides a rational basis for the creation of innovative beauty products and techniques.

Shiseido's R&D philosophy: “DYNAMIC HARMONY”

- Shiseido Formulates its Unique R&D philosophy “DYNAMIC HARMONY” (2021)

<https://corp.shiseido.com/en/news/detail.html?n=0000000003252>

The DYNAMIC HARMONY special website: <https://corp.shiseido.com/en/rd/dynamicharmony/>

<Reference information>

Driving Shiseido's research forward

- A leading figure in global cosmetics research and development: Shiseido Fellow, Tomonobu Ezure, Ph.D.

Dr. Ezure is the only researcher to have been honored with the title of Fellow in Shiseido's 150-year history. He has achieved the unprecedented feat of receiving four consecutive top awards, the most prestigious in the cosmetics field, at the Congress of The International Federation of Societies of Cosmetic Chemists (IFSCC*), as well as various awards at other international conferences.

* IFSCC: An international organization founded in 1959 with the participation of cosmetic societies from around the world.

URL: <https://ifsc.org/>



Shiseido Fellow, Tomonobu Ezure

- Overcoming the limitation of cosmetics

The shape of the face changes dramatically as we age, and it was believed that cosmetics could not address these changes. Dr. Ezure took on this difficult challenge. However, there was lack of even static information about facial aging, and thus he and his team needed to define the various phenomena involved in facial aging and to develop evaluation methods from scratch.

- Establishment of a world-leading research presence

Through fundamental research, Dr. Ezure has revolutionized the general understanding of facial aging, and established many new theories and solutions in skin care science (*).

These findings were presented at successive IFSCC Congresses, where their importance was recognized, resulting in an unprecedented four consecutive top awards. Thus, the importance of the new field of "facial aging" established by Dr. Ezure was acknowledged by the global cosmetics industry.



Award ceremony at Orlando

- Shiseido develops new products to improve sagging skin

Based on Dr. Ezure's research, sagging has been recognized as an aging phenomenon in which the skin is deformed due to gravity, and sagging has been shown to underlie many of the characteristic changes observed in aged facial skin. By applying this research, Shiseido has cultivated a new skincare field, focused on improving sagging skin, which is a major concern of consumers, especially in aging societies throughout the world.

*Major findings of Shiseido's facial aging research

- Fat controls facial aging: Discovered that subcutaneous fat controls the aging of skin and face.
- Anchoring structure: Discovered an anchoring structure of the facial skin that retains the skin in place, and showed that loss of this structure with aging leads to sagging.
- Dermal cavitation: Discovered that skin defects develop with aging (designated as dermal cavitation), leading to an aged facial appearance.
- Dermal cell network: Discovered a network structure formed by interconnected skin cells (fibroblasts), and clarified that this network acts as anti-aging system for the cells and the skin.

【Related news releases】

Shiseido Develops Eye Care Exercises to Improve Droopy Eyelids and Forehead Wrinkles (2011)

https://corp.shiseido.com/jp/newsimg/archive/00000000001298/1298_p8d24_jp.pdf (Japanese only)

Shiseido Clarifies Skin Structure of Supporting Face Shape for the First Time in the World (2015)

https://corp.shiseido.com/jp/newsimg/archive/00000000001927/1927_w4y67_jp.pdf (Japanese only)

Shiseido Discovers That Age-Related Dermal Cavitation Leads to Sagging Skin (2015)

https://corp.shiseido.com/jp/releimg/2512-j.pdf?rt_pr=tr437 (Japanese only)

Shiseido Elucidates Mechanism of Age-Related Dermal Cavitation (2016)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000001958> (Japanese only)

Shiseido Clarifies “Propagation of Aging” in the Inner Skin (2018)

<https://corp.shiseido.com/en/news/detail.html?n=00000000002569>

Shiseido Elucidates the “Fibroblast Network” of Cells in Dermis (2020)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000002898> (Japanese only)

Shiseido Develops “Digital 3D Skin”, a New Skin Analysis Technology Using AI (2020)

<https://corp.shiseido.com/jp/news/detail.html?n=00000000002897> (Japanese only)

Shiseido Reveals Pressure Awakens Skin Regeneration Ability (2020)

<https://corp.shiseido.com/en/news/detail.html?n=00000000002912>

【News releases related to the IFSCC award】

Shiseido Wins Top Award at 28th IFSCC Congress (5 consecutive awards) (2014)

https://corp.shiseido.com/jp/newsimg/archive/00000000001739/1739_f9g77_jp.pdf (Japanese only)

Shiseido Wins the Poster Award at the 29th IFSCC Congress in Orlando (2016)

<https://corp.shiseido.com/en/news/detail.html?n=00000000002061>

Shiseido Wins 7th Consecutive Top Award at the 30th IFSCC Congress in Munich (2018)

<https://corp.shiseido.com/en/news/detail.html?n=00000000002530>

Shiseido Wins Top Award at 31st IFSCC Congress 2020 in Yokohama, Japan (2020)

<https://corp.shiseido.com/en/news/detail.html?n=00000000003002>