

〈教育セミナー〉

第49回教育セミナー（2024）・「皮膚から“情報”を得る～ヒトの皮膚こそデータの宝庫～」

顔の情報からからだ・こころの状態を知る

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Estimation of Physiological and Psychological States from Facial Information

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Abstract

In modern healthcare, the ability to noninvasively estimate physiological and psychological states is increasingly important for early detection of subclinical conditions and personalized care. This study presents a hybrid facial analysis system that integrates facial images, facial videos, and self-recognition data to estimate three key domains of stress and health status: physical, autonomic, and mental indicators. Facial stratum corneum images were also examined as a supplementary input for physical stress estimation.

Using data from a total of 5,430 participants, we developed machine learning models to estimate stress-related conditions such as fatigue, sleep disturbances, autonomic imbalance, and depressive symptoms. Each model demonstrated predictive accuracy above 70%, confirming the feasibility of facial-based estimation. In particular, facial images were used for physical stress estimation, facial videos for autonomic stress (through analysis of skin color dynamics and heart rate variability), and facial self-perception for mental stress.

Furthermore, we implemented selected facial analysis techniques into a smartphone-based tool incorporating vibro-acoustic relaxation content. Intervention studies confirmed its effectiveness: the system improved both subjective stress-related scores (*e.g.*, depression, anxiety, sleep quality) and objective stress biomarkers such as salivary cortisol. Over 70% of users reported enhanced relaxation and a willingness to continue use.

These findings suggest that facial information is a valuable, noninvasive source for multidimensional health assessment. Our hybrid approach enables efficient, real-time monitoring and supports personalized stress management. This approach may also contribute to broader applications in digital health, preventive wellness, and, in the future, the early detection of pre-disease states through collaboration with medical institutions.

Key words: facial analysis, state estimation, machine learning, psychophysiology, digital health.