Automated Analysis and Synthesis of Facial Actions

Itır Önal Ertuğrul

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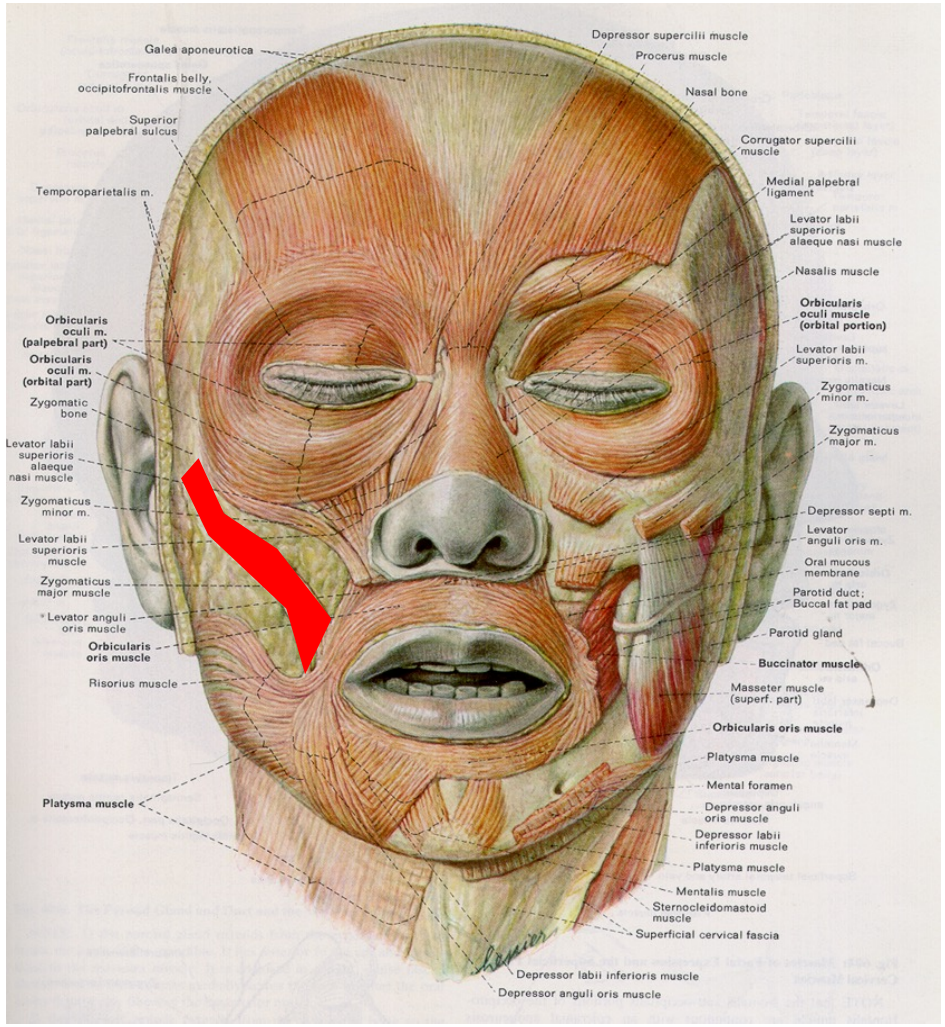
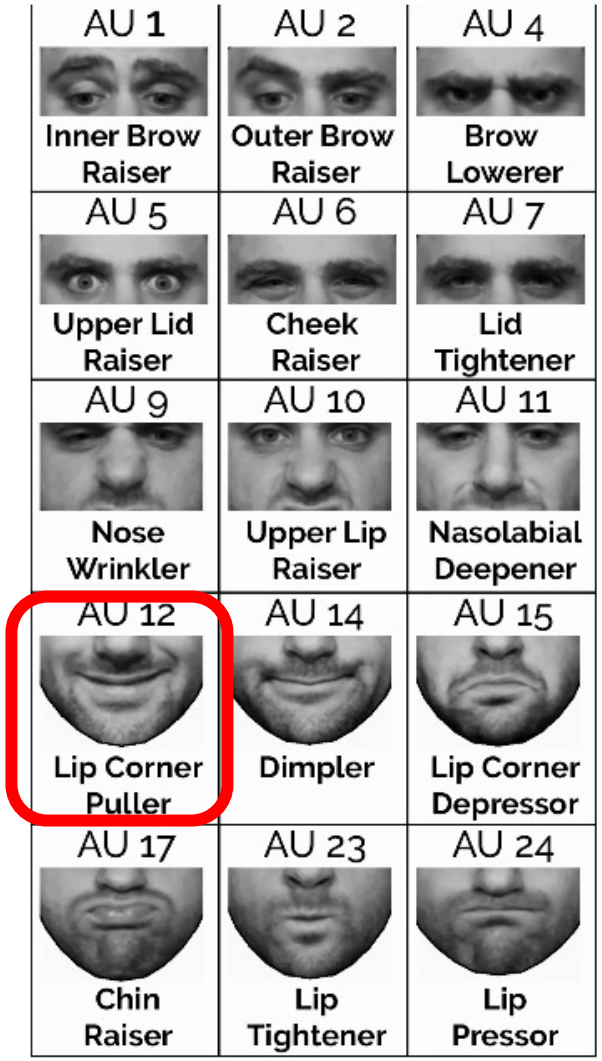
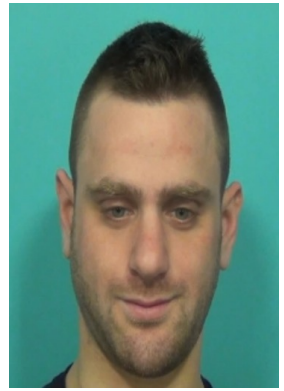
Utrecht University

Facial Action Units (AUs)

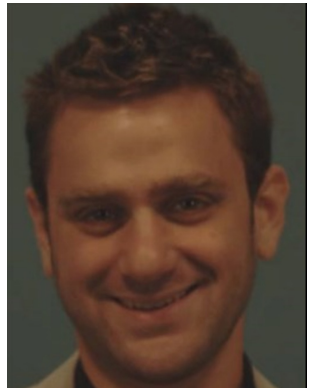
Facial Muscles







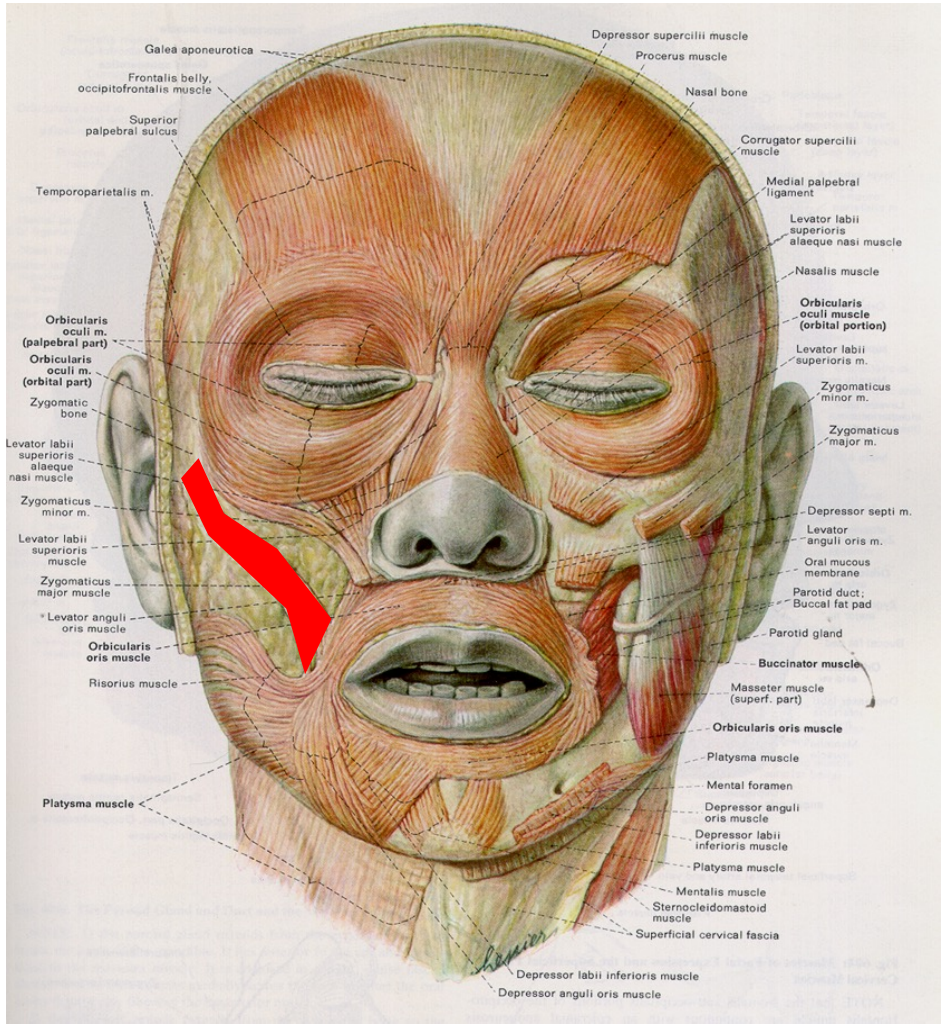
Social smile
AU12



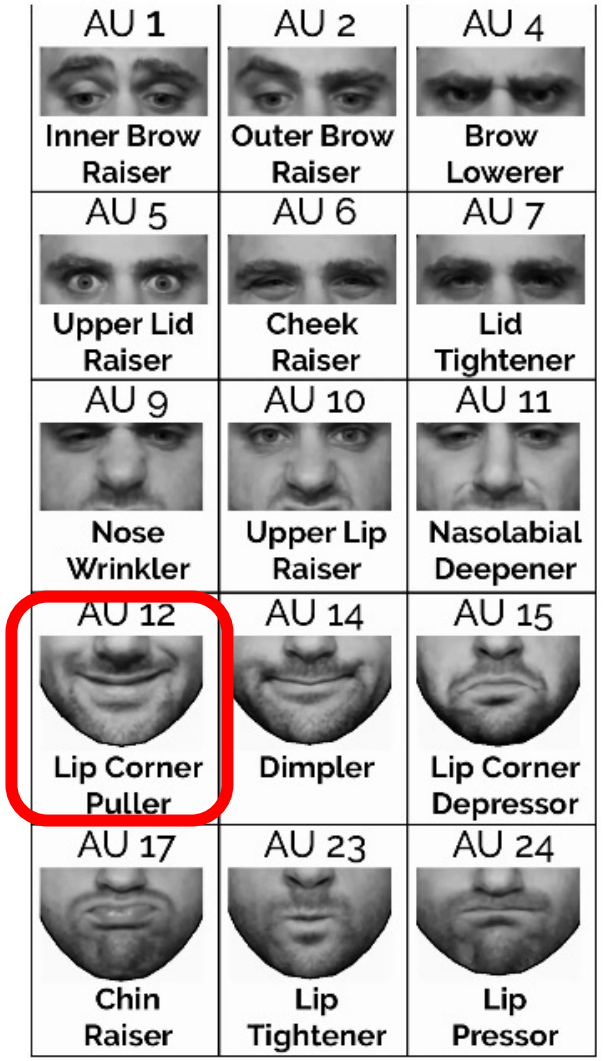
Enjoyment smile
AU6 + AU12

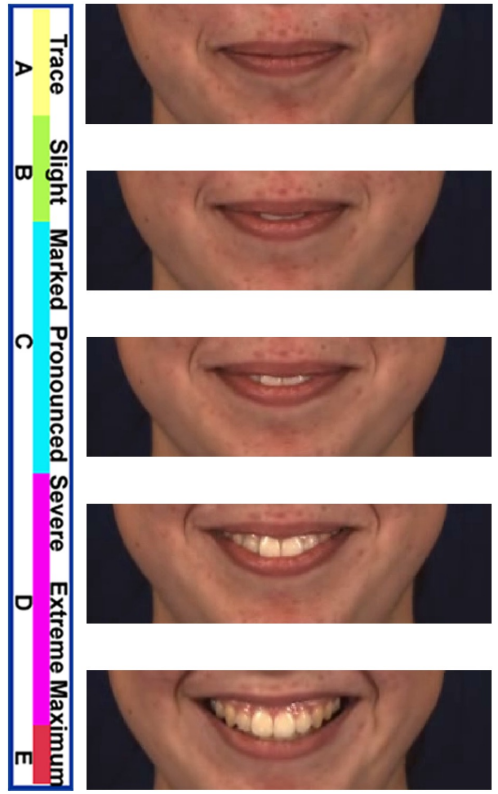
Facial Action Units (AUs)

Facial Muscles

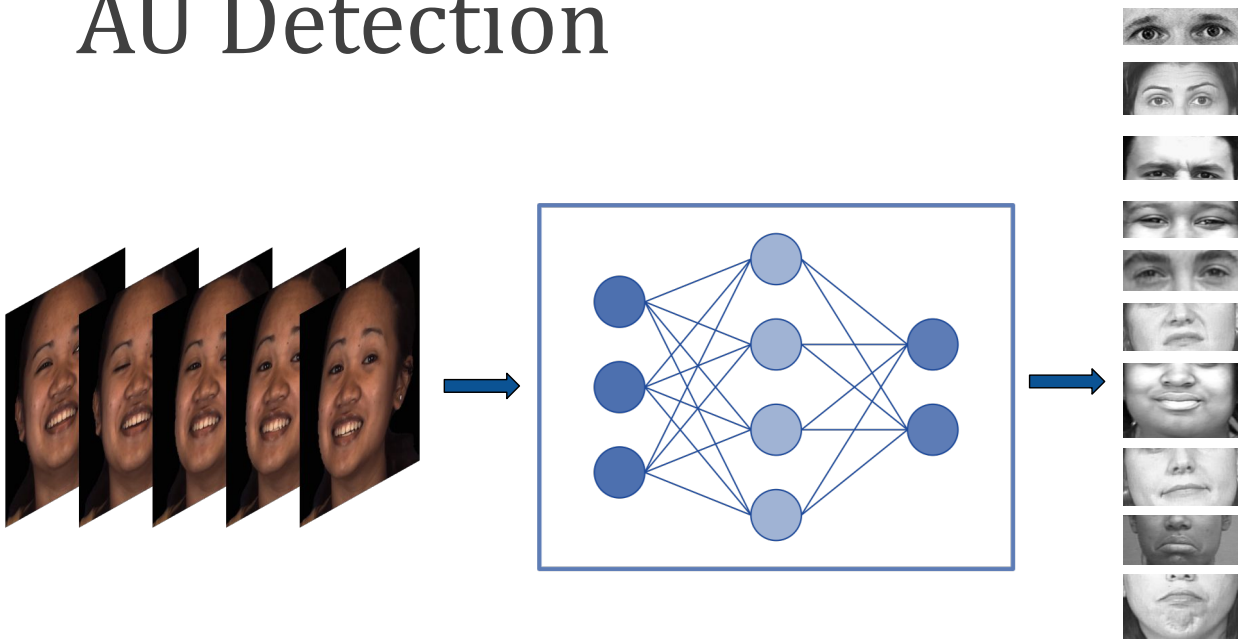


Occurrence + Intensity

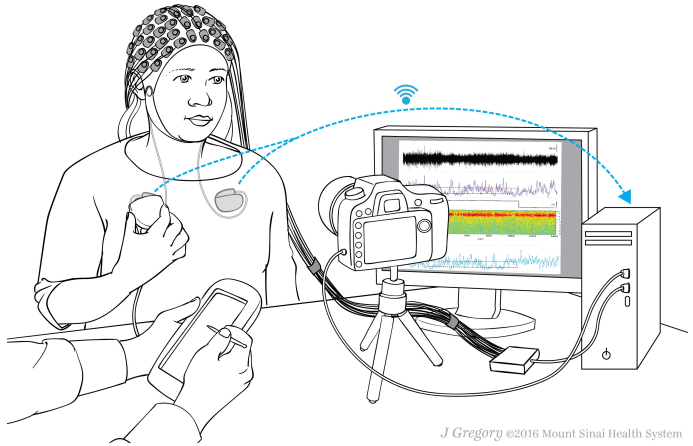




AU Detection

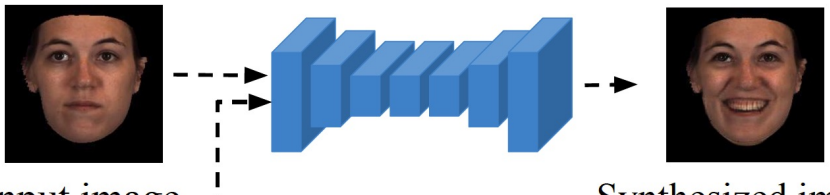


Applications



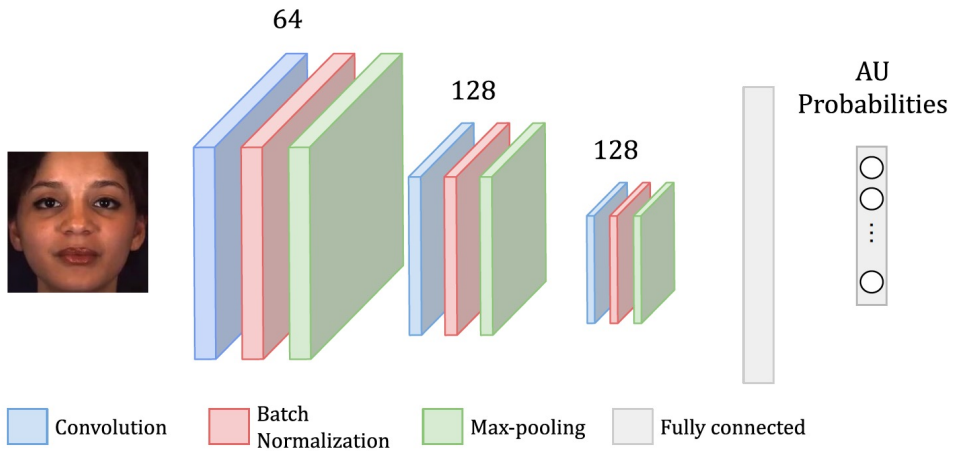
Treatment of disorders

AU Synthesis



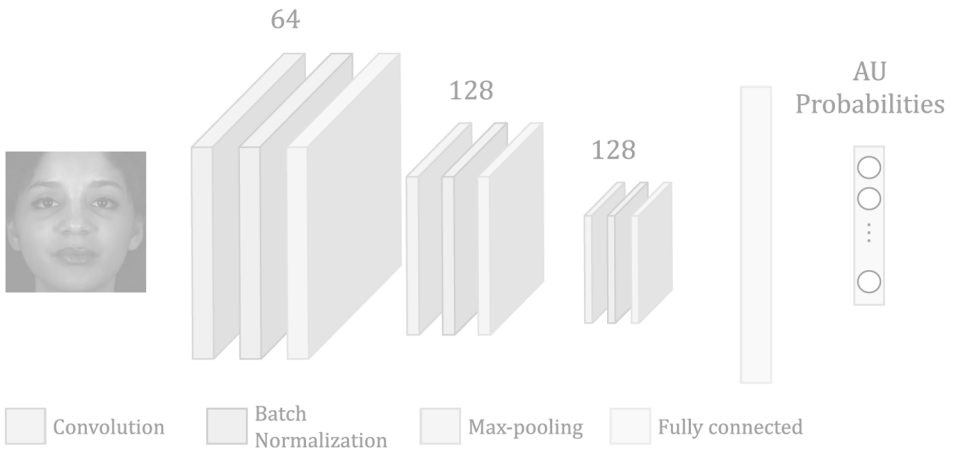
Dyadic Interaction

(M1) Spatial and holistic face

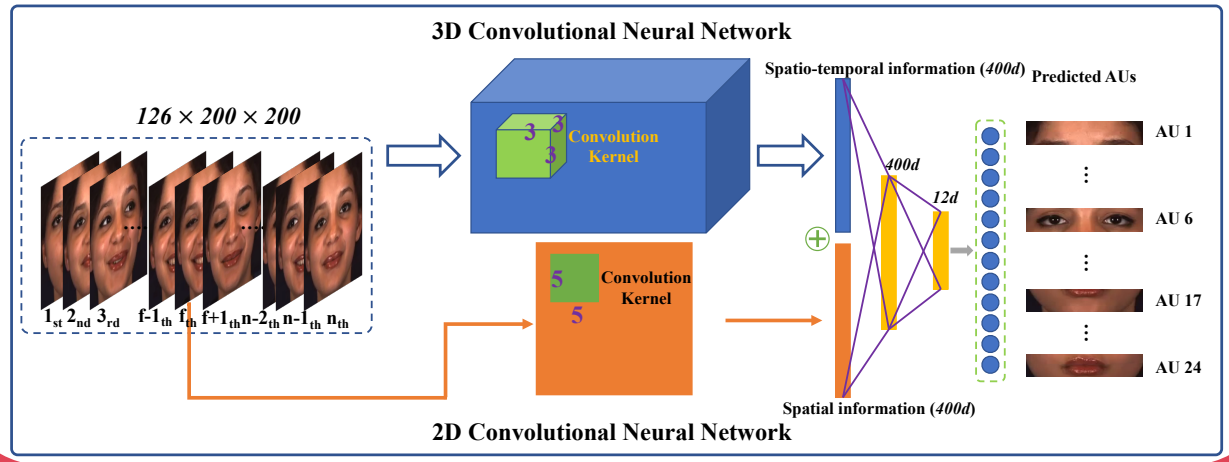


I. Onal Ertugrul, L. A. Jeni, W. Ding, and J, F. Cohn, AFAR: A Deep Learning Based Tool for Automated Facial Affect Recognition, *FG*, 2019

(M1) Spatial and holistic face

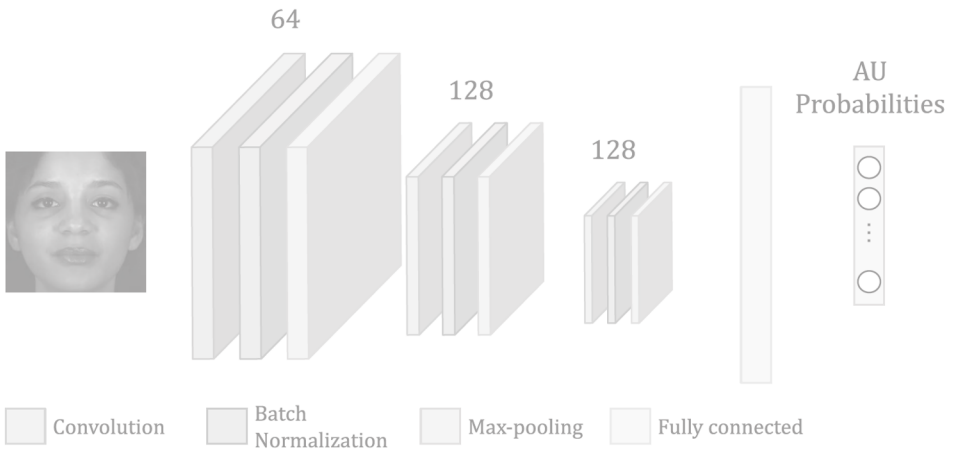


(M2) Spatio-temporal and holistic face

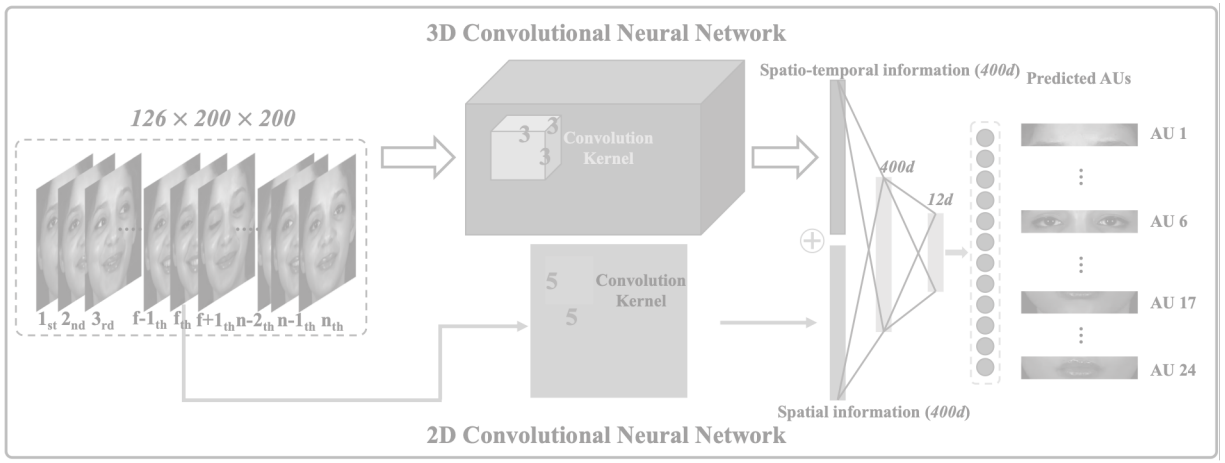


L. Yang, **I. Onal Ertugrul**, J. F. Cohn, Z. Hammal, D. Jiang, H. Sahli, FACS3D-Net 3D Convolution based Spatiotemporal Representation for Action Unit Detection, *ACII,* 2019

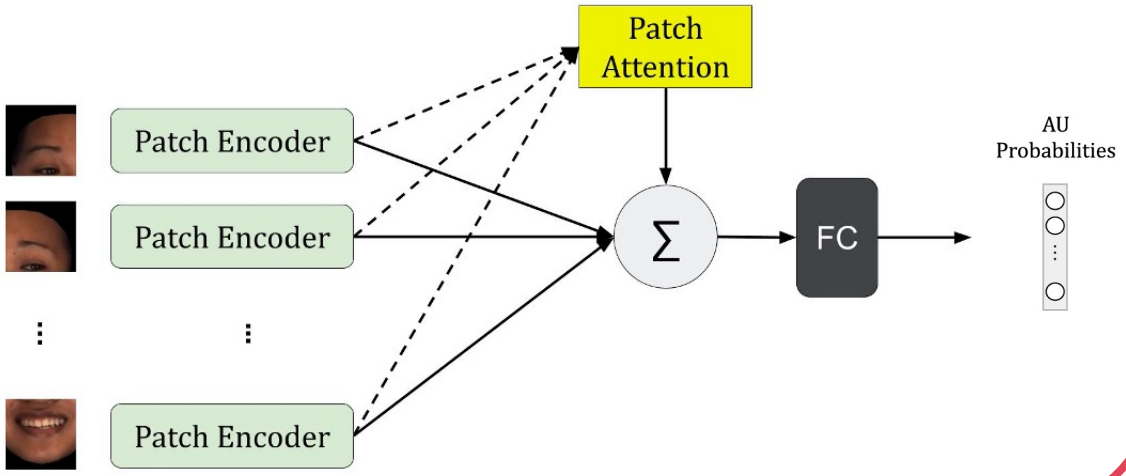
(M1) Spatial and holistic face



(M2) Spatio-temporal and holistic face

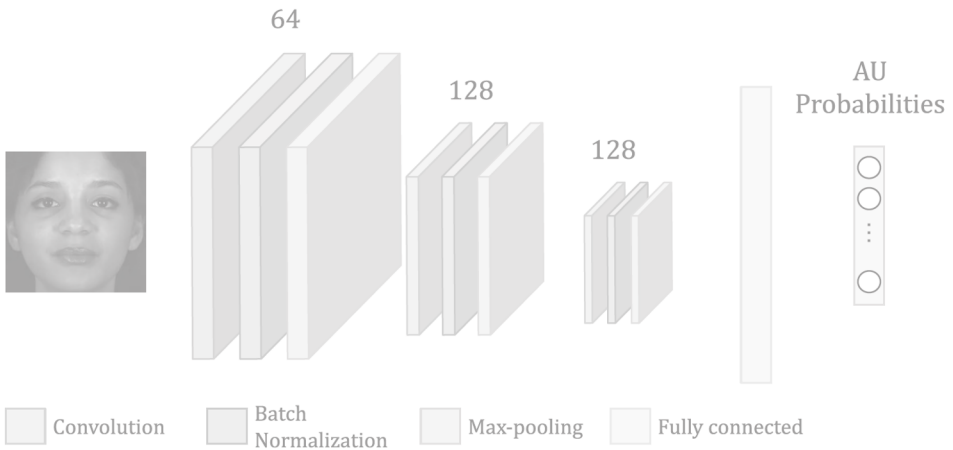


(M3) Spatial and patch-based



I. Onal Ertugrul, L. A. Jeni, and J. F. Cohn, PAttNet: Patch-Attentive Deep Networks for Action Unit Detection, *British Machine Vision Conference (BMVC)*, 2019

(M1) Spatial and holistic face



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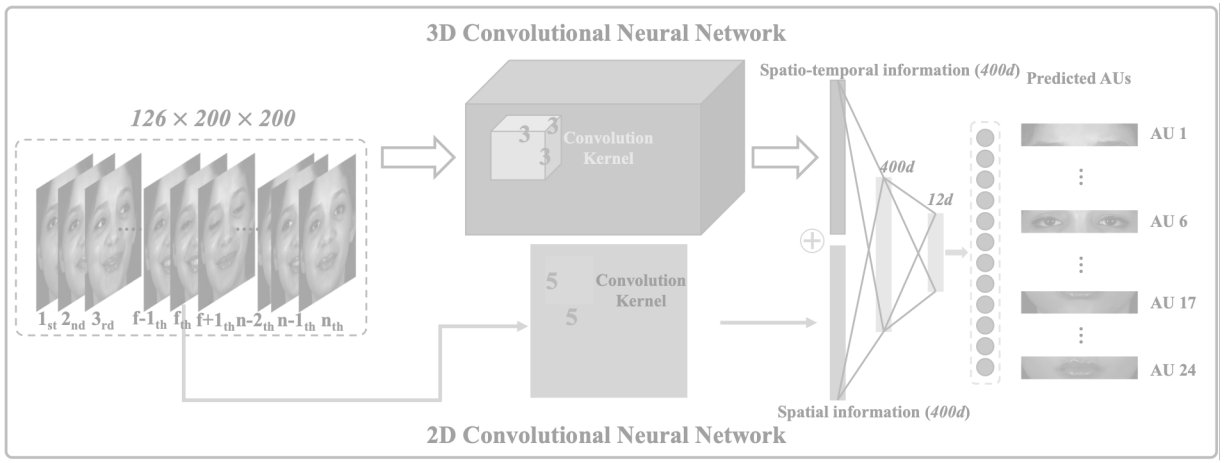

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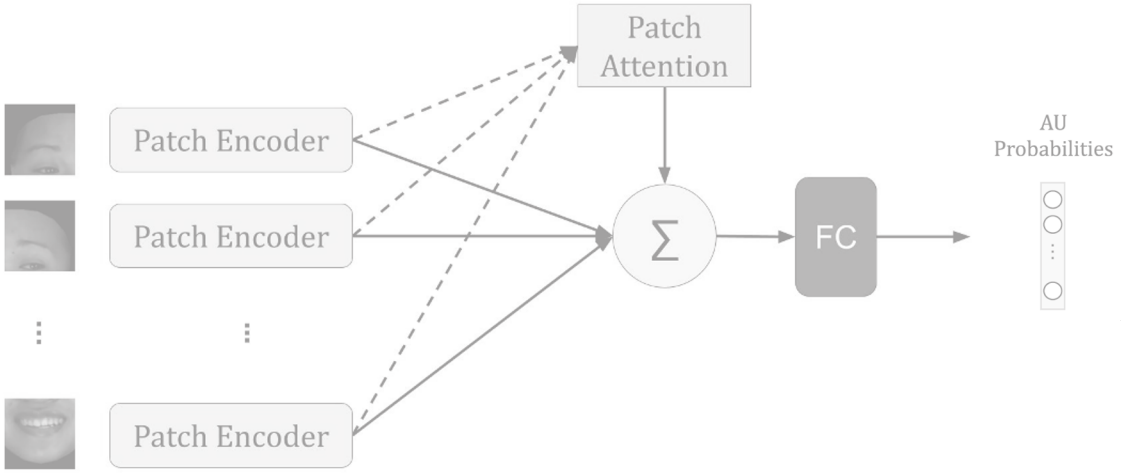
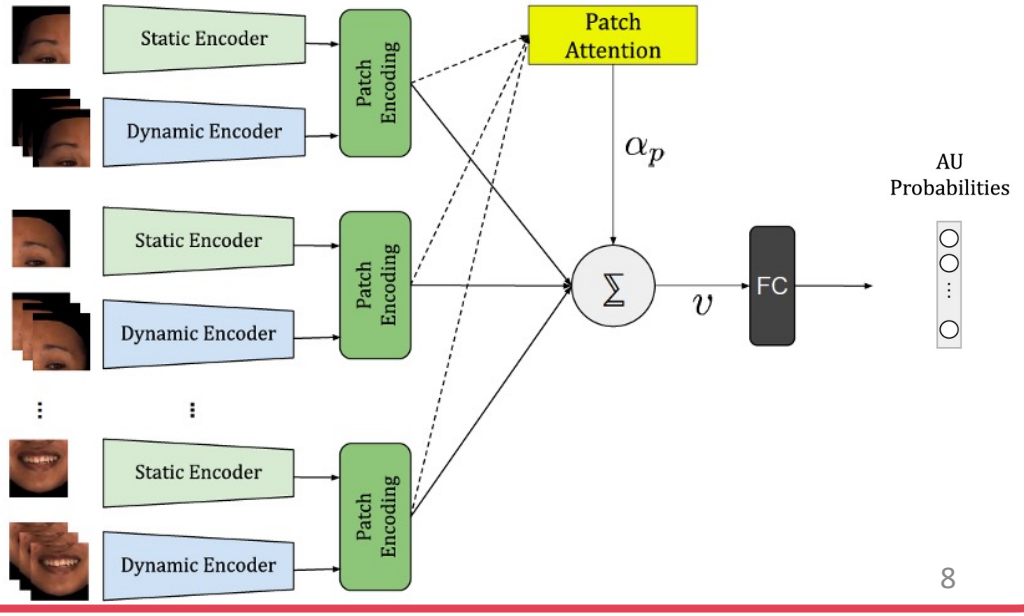
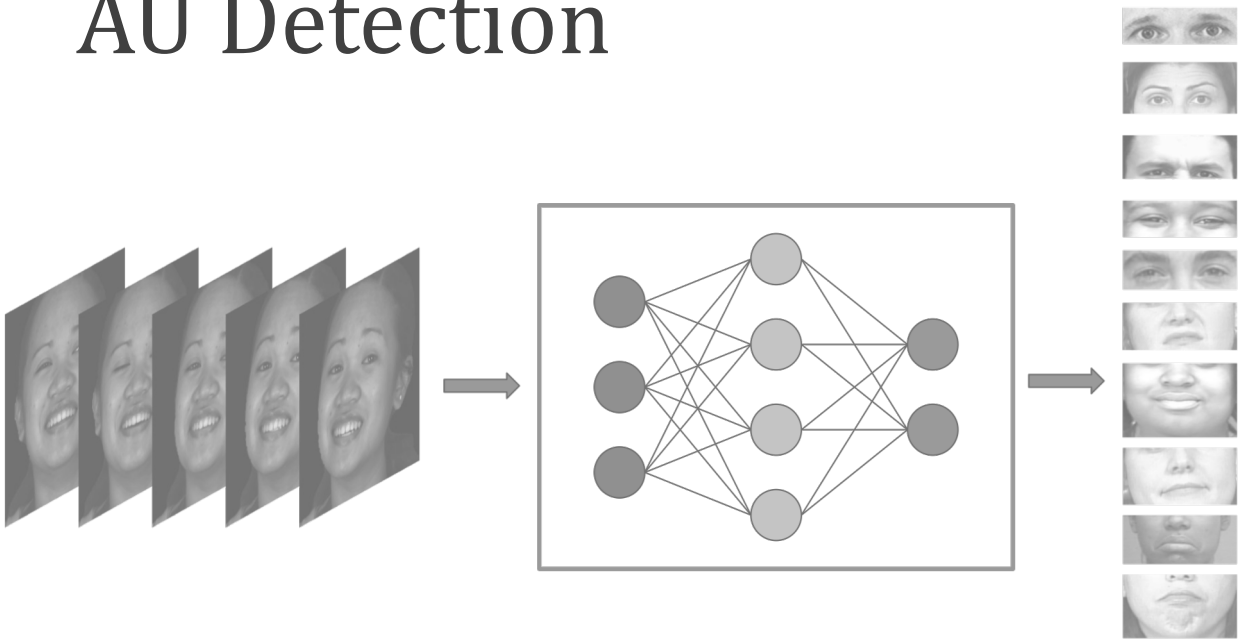


(M4) Spatio-temporal and patch-based

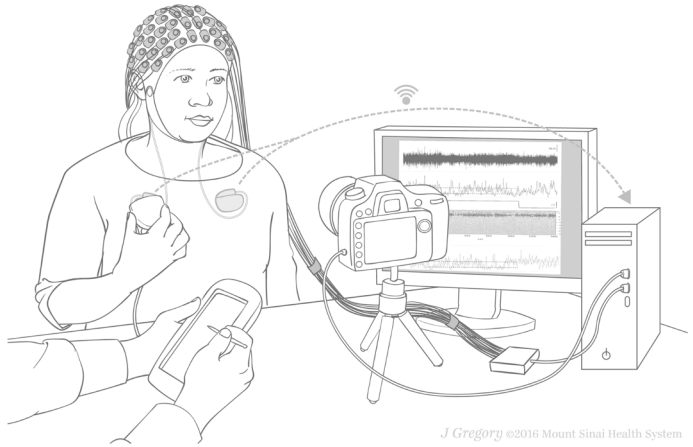


I. Onal Ertugrul, L. Yang, L. A. Jeni, and J. F. Cohn, D-PAttNet: Dynamic Patch-Attentive Deep Networks for Action Unit Detection, *Frontiers in Computer Science,* 2019

AU Detection

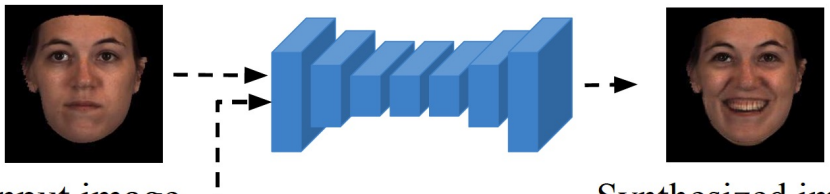


Applications



Treatment of disorders

AU Synthesis

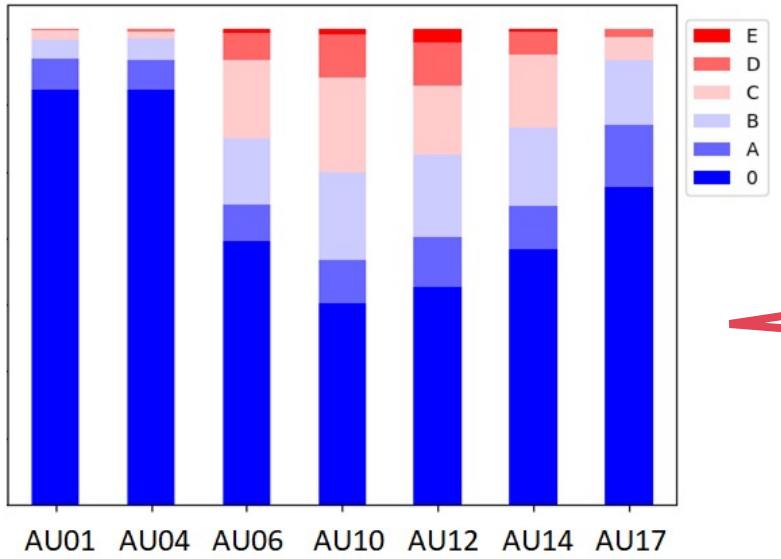


Dyadic Interaction

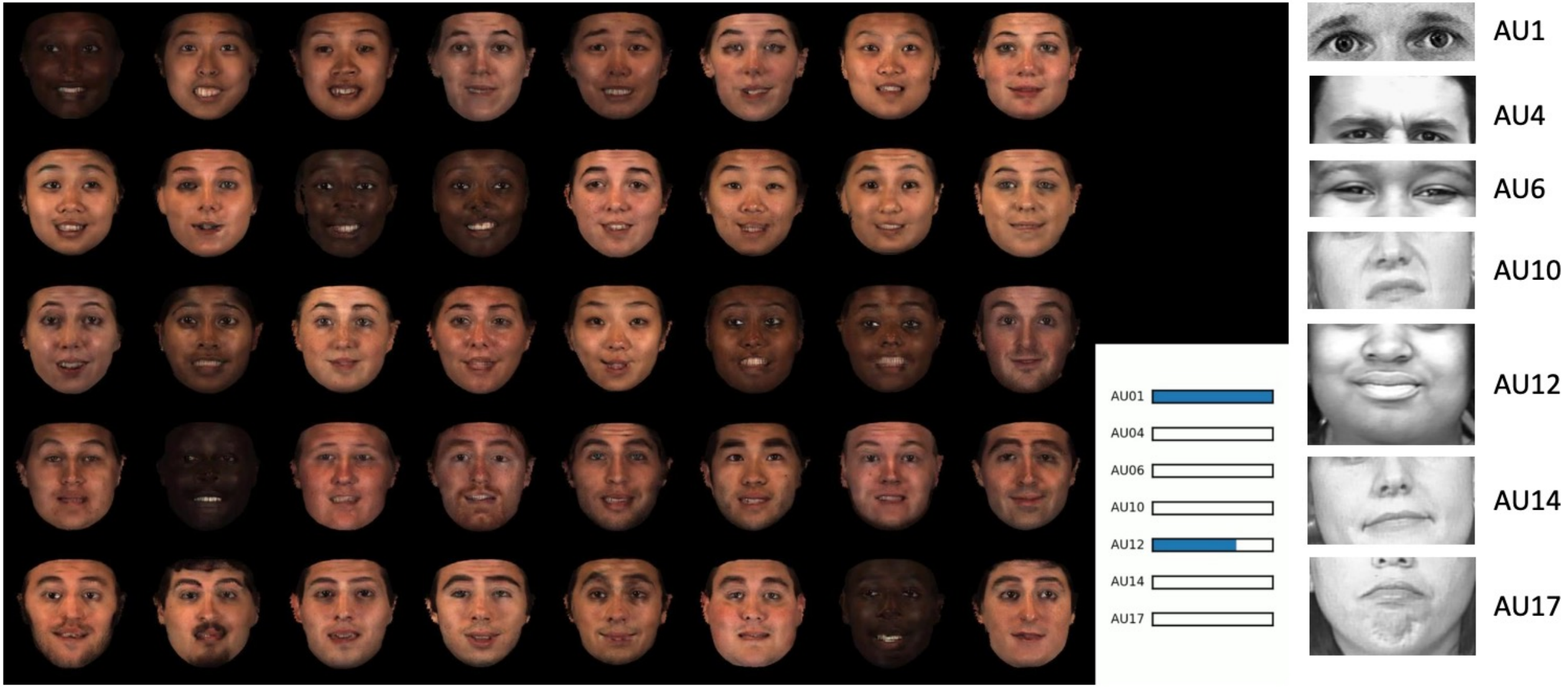
Problems of available facial expression databases

- Limited number of AU annotated frames
  - Expert FACS annotators are relatively few
  - AU annotation of a single minute of video typically requires one to three hours

- Skewed AU intensity labels



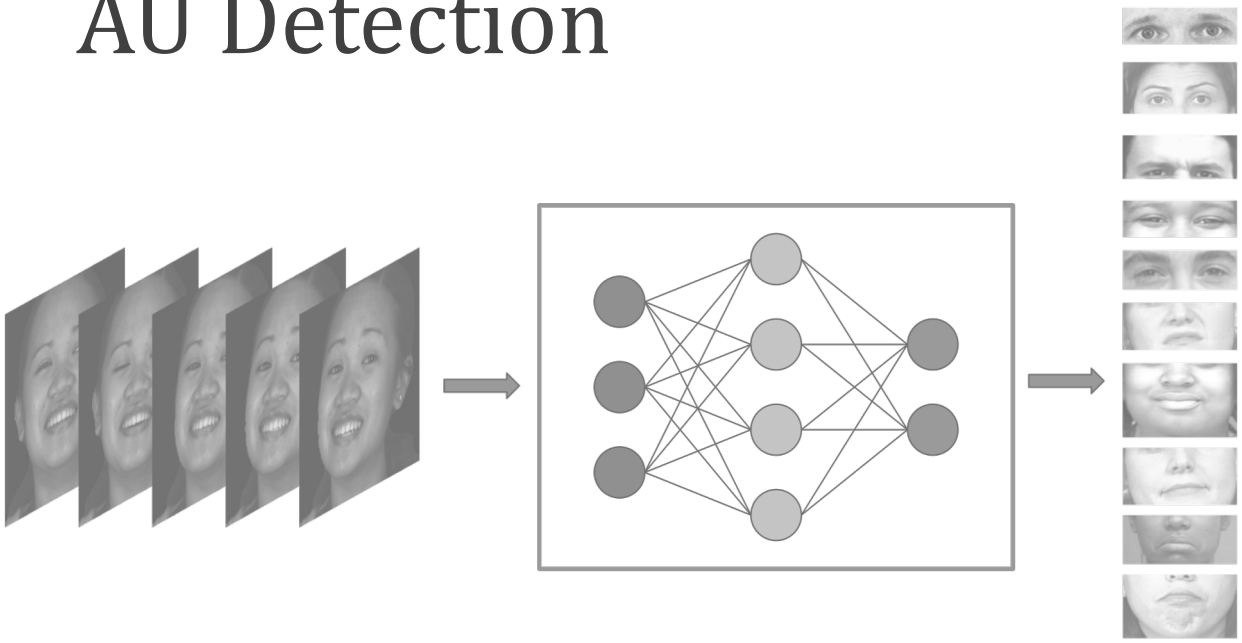
Large, AU-balanced database



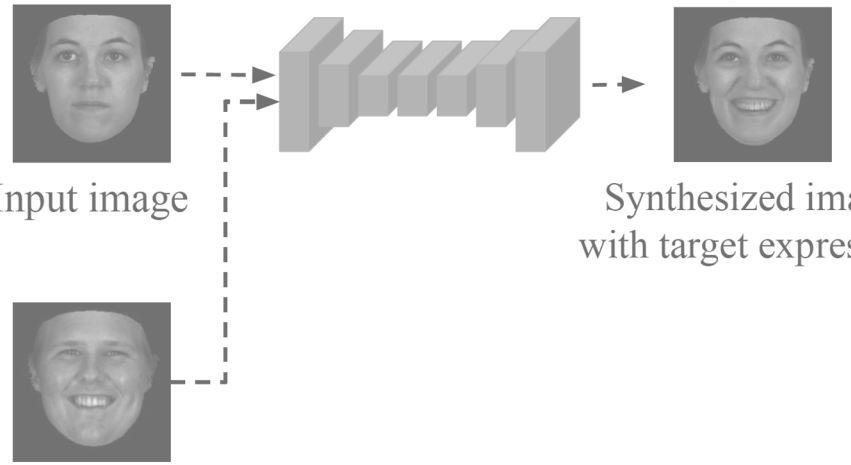
K. Niinuma, **I. Onal Ertugrul**, J. F. Cohn, and L. A. Jeni, Synthetic Expressions are Better Than Real for Learning to Detect Facial Actions.
In *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV),* 2021.

https://kniinuma.github.io/SyntheticExpressionBetterThanReal/

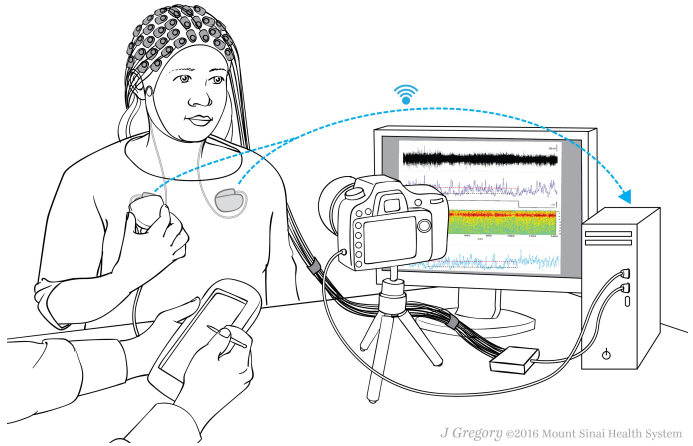
AU Detection



AU Synthesis



Applications



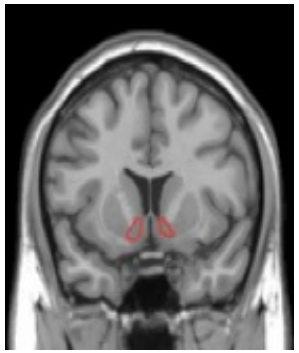
Treatment of disorders

Dyadic Interaction

(A1) Deep Brain Stimulation for Obsessive Compulsive Disorder

Deep Brain Stimulation (DBS):

- Electrodes are implanted into Ventral Striatum
- **Potential side effects**: Hypomania



Use automated measurement of facial actions to:

- Detect affect of the subject
- Adjust parameters of DBS device accordingly

N. Provenza et al., Long-term ecological assessment of intracranial electrophysiology synchronized to behavioral markers in Obsessive-Compulsive Disorder, *Nature Medicine,* 2021

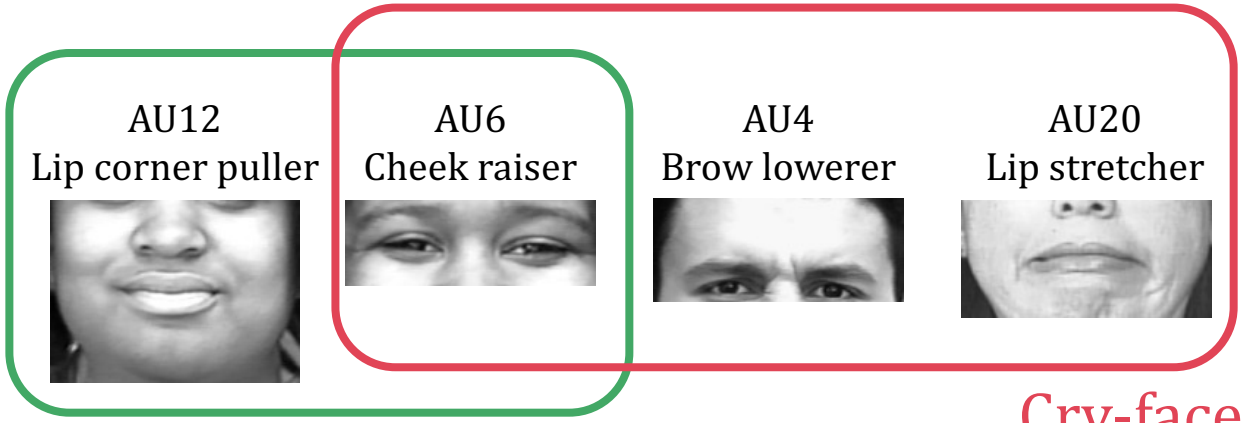
J. F. Cohn, L. A. Jeni, **I. Onal Ertugrul**, D. Malone, M. Okun, D. Borton, and W. Goodman, Automated Affect Detection in Deep Brain Stimulation for Obsessive Compulsive Disorder: A Pilot Study, *ICMI*, 2018.

(A2) Mother-infant interaction

Face-to-Face (FF)

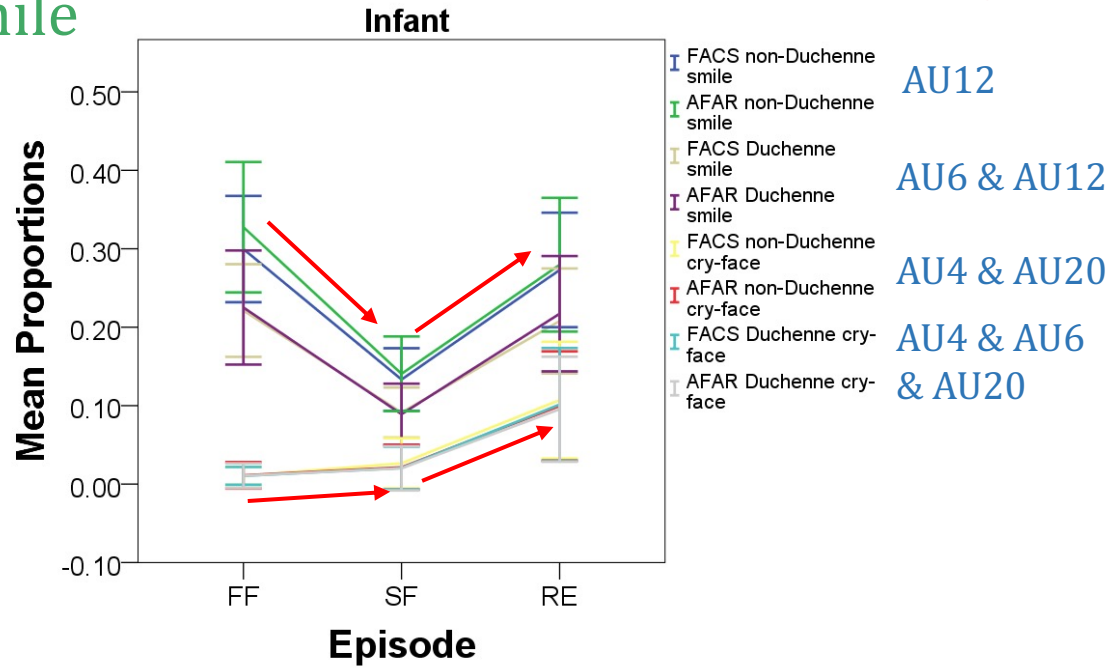
Still-Face (SF)

Resume (RE)



Cry-face

Smile



AU12

AU6 & AU12

AU4 & AU20

AU4 & AU6 & AU20

Y. A. Ahn, T. Bak, **I. Onal Ertugrul**, C. Banarjee, P. Davila, S. Chow, J. F. Cohn, D. S. Messinger, Concordant still-face findings for computer vision and expert FACS coders, *International Congress of Infant Studies*, 2020

Ongoing work

(1) AI driven e-health solution to help patients conquer needle fear

Problems:

- People avoid visiting doctors.
- Experience vasovagal reactions (e.g. fainting)

Proposed solution:

- Adapting a serious game that helps patients conquer needle fear
- Monitor facial behavior, vital signs, and vasovagal reactions to adjust game

In collaboration with Tilburg University and Elisabeth-TweeSteden Ziekenhuis (ETZ)

Ongoing work

(2) Facial action detection in specific age-groups

Infants: Infant AFAR
Older adults: Synthesis & detection

(3) Computational analysis of entrepreneurial pitches

- Investigate decision-making in entrepreneurial contexts involving social interactions
- Use nonverbal behavior of entrepreneur/investor and their interaction to estimate likelihood of investment

In collaboration with Tilburg University and Jheronimus Academy of Data Science (JADS)

Thank you!

Questions?

i.onalertugrul@uu.nl

Utrecht University