Recent Advances and Challenges in Facial Micro-Expression Analysis

Introduction & Overview

John See  Multimedia University, Malaysia
Moi-Hoon Yap  Manchester Metropolitan University, UK
Su-Jing Wang  Chinese Academy of Sciences, China
Jingting Li  Chinese Academy of Sciences, China
Sze-Teng Liong  Feng Chia University, Taiwan
Tutorial Organizers

John See  
Multimedia University, Malaysia

Moi Hoon Yap  
Manchester Metropolitan Univ., UK

Jingting Li  
Institute of Psychology, Chinese Academy of Sciences, China

Sujing Wang  
Institute of Psychology, Chinese Academy of Sciences, China

Sze-Teng Liong  
Feng Chia Univ., Taiwan
Outline of Tutorial

- **Part 1:** Introduction & Overview to Facial Micro-expression (ME) Analysis
- **Part 2:** ME Datasets
- **Part 3:** ME Spotting Task
- **Part 4:** ME Recognition Task
- **Part 5:** Challenges and Future Directions
Clinton v Trump 1st debate

anger  contempt  sadness  surprise

CREDIT: RBC NETWORK BROADCASTING
Duchenne Smile: Occurs when the zygomaticus major muscle lifts the corners of your mouth at the same time the orbicularis oculi muscles lift your cheeks and crinkle your eyes at the corners.

Vandeventer & Patterson (2012) Differentiating Duchenne from non-Duchenne smiles using active appearance models. BTAS.
• **Haggard and Isaacs (1966)** – discovered micro-expressions while scanning through motion picture films of psychotherapy hours, looking for clues of non-verbal communication.

• **Ekman and Friesen (1969)** spotted a quick full-face emotional expression in a filmed interview – a strong negative feeling a psychiatric patient was trying to hide from her psychiatrist to convince that she is no longer suicidal.
  - **Slow motion** – shows a brief sad face lasting only 2 frames (1/12 seconds) followed by a longer duration false smile.
Major Structures of the Brain

Forebrain
- Cerebral Cortex: Higher mental functions including thinking, language, learning, memory, emotions, and control of voluntary movement.
- Corpus Callosum: Bundle of nerve fibers that connect the two cerebral hemispheres.
- Thalamus: Relay station for sorting and integrating sensory input; regulation of sleep-wake cycles.
- Limbic System: Emotional processing, motivated behavior, and learning and memory functioning; consists of amygdala, hippocampus, parts of the hypothalamus and thalamus, and nearby structures.
- Basal Ganglia: Regulation of movement and coordination.

Hindbrain
- Pons: Conveying sensory information from the spinal cord to the forebrain; regulation of states of wakefulness and sleep.
- Cerebellum: Regulation of balance and coordination.
- Medulla: Conveying sensory information from the spinal cord to the forebrain; control of basic bodily processes including heart rate, breathing, and certain reflexes.
“Amgydala hijack”

⇒ Emotional response that is immediate, overwhelming and out of measure with actual stimulus
First baby steps forward

- **Porter and ten Brinke (2008)** – first report published validating the existence of micro-expressions

- **Matsumoto et al. (2000)** – first report published about tests designed for the ability to recognize micro-expressions

- **Ekman (2003)** – Micro-expression Training Tool (METT) was designed


**Micro-expressions** ➔ Result of a **voluntary** and **involuntary** emotional response that conflicts with one another.

- The amygdala (the emotion centre of the brain) responds to the stimuli that the individual experiences and the individual wishes to conceal this specific emotion.
- Resulting effect ➔ the individual very briefly displays his/her true emotions followed by a “clipped” emotional reaction back to the previous state.

3 main characteristics:

- Rapid and short duration: 1/25 second – 1/5 second
- Subtle: Low intensity of expression
- Fragmented/partial facial action units

AU4: Onset, Apex, Offset

AU4 (right inner brow) lowers a little bit at 110ms = Disgust
Macro vs. Micro

**Macro-Expressions**
- Typically ¾ – 2 seconds
- Occurs over a larger region of the face
- Voluntary response
- Typically a genuine feeling (though it can be faked)
- Easy interpretable by anybody

**Micro-Expressions**
- Last for 1/25 to 1/5 of a second
- Occurs at a small, concentrated area (often just one facial region)
- Involuntary action (not amounting to faking it)
- Concealment of a genuine feeling
- Not easily identifiable by an untrained layperson
Universal Expressions of Emotion... as according to Ekman

Normal expressions

Micro-expressions
Deconstructing Micro-Expressions

- **Anger**
  - eyebrows down and together
  - eyes glare
  - narrowing of the lips

- **Disgust**
  - nose wrinkling
  - upper lip raised

- **Fear**
  - eyebrows raised and pulled together
  - raised upper eyelids
  - tensed lower eyelids
  - lips slightly stretched horizontally back to ears

- **Happiness**
  - crow’s feet wrinkles
  - pushed up wrinkles
  - movement from muscle that orbits the eye

- **Sadness**
  - drooping upper eyelids
  - losing focus in eyes
  - slight pulling down of lip corners

- **Surprise**
  - lasts for only one second
  - eyebrows raised
  - eyes widened
  - mouth open

- **Contempt**
  - lip corners tightened
  - raised on only one side of face
Books...
Movies...
Popular culture
Applications

- Interviews
- Business Negotiations
- Criminal Interrogation
- Clinical Diagnosis
- Political Debates
- High-stakes Games (Poker, Game Shows etc.)
Can machines play a part?

- Micro-expressions are typically captured by high speed cameras and observed through replaying them at slower speeds.
- Frank et al. (2009)'s Experiment: Performance of detecting MEs by people who undergo METT reach at most 40%, unaided US Coast Guards performed not more than 50% at best.

- Can researchers in computer vision / video processing / machine learning help to automate the task?
Micro-Expression Analysis Tasks

**Input**
- Long Video (Untrimmed)
- Short Video (Trimmed)

**ME Spotting**
- ME Window

**ME Recognition**
- Apex Frame

**ME Classes**
- **A relatively “young” field**
  - Bloomed circa 2013-2014 with the establishment of spontaneous facial ME datasets from University of Oulu (SMIC) and the Chinese Academy of Sciences, China (CASME, CASME II)

- **Survey paper:**
  - “A Survey of Automatic Facial Micro-expression Analysis: Databases, Methods and Challenges”, Oh et al., Frontiers in Psychology, 2018

- **Pipelines for ME spotting and recognition**
  - Known pipelines for these two tasks have been established
  - Merging them into a single seamless task is still challenging and a road less travelled (only 2 papers on this!)
Facial Micro-Expression Analysis: Current State of Interest

Number of works on Facial ME (spotting & recognition)

- SMIC and CASME II datasets
- 1st ME Grand Challenge
A Survey of Automatic Facial Micro-Expression Analysis: Databases, Methods, and Challenges

Yee-Hui Oh, John See, Anh Cat Le Ngo, Raphael C. -W. Phan and Vishnu M. Baskaran

Over the last few years, automatic facial micro-expression analysis has garnered increasing attention from experts across different disciplines because of its potential applications in various fields such as clinical diagnosis, forensic investigation and security systems. Advances in computer algorithms and video acquisition technology have

- Comprehensive review
- An updated survey expected in 2021
- BOTH spotting and recognition tasks covered
- Open Access!
End of Part 1

Questions?