FACS at 40

Facial Action Coding System Panel

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Figure 1: Expression scanning in a Light Stage.

ABSTRACT

Creating emotionally impactful characters has been one of the biggest challenges in computer graphics. Key to this has been understanding how faces express emotion. In 1978 research started in coding human expressions. The Facial Action Coding System (FACS) would become one of the cornerstones of facial animation of digital characters. Today FACS is recognized as the gold standard in scientific facial research and animation. Forty years on, we discuss the strengths and limitations of FACS, its relevance in the age of Machine Learning and what people are doing to improve upon FACS in animation.

The panel features leading experts: J.P. Lewis, Erika Rosenberg, Vladimir Mastilovic, Mark Sagar and hosted by Mike Seymour.

CCS CONCEPTS

• **Computing methodologies** → **Motion processing**.

KEYWORDS

virtual humans, agents, nonverbal behavior, self-disclosure, Facial Action Coding System, facial expressions, facial simulation

1 FACIAL ACTION CODING SYSTEM (FACS)

Humans are uniquely attuned to faces, and they present a challenge unlike anything else [Meng et al. 2012]. There are several ways to animate a facial model, or rig the face for later animation. The primary method is the widely used blend shape rig which moves between expressions for different parts of the face via a notional slider or value. This approach is usually based wholly or in part on expressions based on FACS action units (AU). For each sub-expression, an animator or motion capture solver can "dial in" a percentage of that sub-expression. AUs are directly linked to facial muscles and FACS-based rigs are a core approach to many successful facial animation pipelines that seek to cross the Uncanny Valley [Mori et al. 2012; Sagar et al. 2016].

A FACS pipeline normally requires actors to strike a series of poses in a separate FACS scanning session (see Figure 1). Focus is placed on the validity of the "performance" and the interrelationship of different parts of the face which can be lost in the subsequent animation stages.

The typical process of creating the range of motion and facial animation rig starts from an actor producing a series of FACS poses. This set of facial expressions is of the order of 40 or so expressions. The FACS poses (and the AUs they are decomposed into) are co-opted from the non-CGI research, especially the work of psychologist Paul Ekman [Ekman 1977; Ekman and Rosenberg 1997]. FACS is a comprehensive, anatomically-based system for exhaustively describing all observable facial movement [Ekman and Friesen 1978]

[Ekman et al. 2002]. It was originally developed to identify and classify observed human facial expressions. There is some disagreement over how far a FACS and blend shape rig approach could go in achieving realism, and whether Machine Learning approaches may offer an alternative, yet it remarkable how widely the FACS approach has been adopted in the animation and visual effects industry [Seymour et al. 2019].

The panel explores a range of issues including:

- FACS relevancy to current rigging
- The history of FACS, pre and post animation adoption
- Extent of the face (âĂŸhockeyâĂŹ mask) and the role of silhouettes
- Human response system to reading faces
- Sampling technology and muscle representations
- Non-linearity of expressions
- Facial Emotion not via movement (Blood flow/Blush/Flush)
- Driving a FACS rig in real time
- The role of simulation
- FACS driven by a cognitive architecture
- The universality of FACS versus universality of emotion
- Why FACS needs blendshapes (and can PCA work or not?)
- A comparison of FACS editing versus direct manipulation
- Issues with combinatorial blendshape explosions
- Prospects for nonlinear blendshapes via deep autoencoders
- What we should revisit from the original FACS research.

2 PANELISTS

The panel consists of the following global experts:

JP Lewis is a staff research scientist at Google AI. In the past he has worked in academic and industrial research labs, as well as in the movie and games industries at Weta Digital, Industrial Light and Magic, ESC, Disney, and elsewhere. He has received credits on a few movies including the Planet of the Apes trilogy, Avatar, The Matrix Sequels, Furious7, and Forrest Gump. Several of his algorithms have been incorporated in commercial software including Maya and MATLAB.

Erika Rosenberg is leading academic, author, consultant, and educator who is recognized as a FACS expert worldwide. She was trained by and has worked extensively with Paul Ekman, one of founders of FACS. Dr. Rosenberg has published in a wide range of journals and books, speaks at international conferences, and consults and trains people in FACS and facial expressions in several disciplines, including academia, business, law enforcement, entertainment, and the digital arts.

Vladimir Mastilovic is founder of 3Lateral, a studio dedicated to creation of high-end characters and creatures for games, cinematics and film. 3Lateral is a world leader in the creation of facial systems. Vladimir is responsible for principal design of the facial rigging pipeline. 3Lateral's facial work balances a range of factors to deliver high end production solutions that are deployed in AAA games internationally.

Mark Sagar is an award winning researcher and facial expert. He is CEO of Soul Machines, which is humanizing the interface between people and machines by bringing technology to life through autonomously animated, emotionally responsive digital humans with virtual nervous systems and embodied cognitive architectures.

Mark is well known for his research at Weta Digital, winning two Sci-Tech Oscars. He is pioneering fully autonomous face to face agent research with his interactive BabyX [Sagar et al. 2016]. He continues to innovate by combining facial animation, human physiology, neuroscience and AI.

3 MODERATOR

Mike Seymour is an avatar and agent researcher in the Motus Lab at the University of Sydney. His research explores using interactive faces as new forms of Human Computer Interfaces, focused on digital avatars and embodied conversational agents. Mike worked in production, winning an AFI and being Emmy nominated. He is perhaps best known for his work as a writer and consultant with the film-tech web site: fxguide.com. Mike lecturers at the University of Sydney in Digital Innovation. He recently presented MEETMIKE at SIGGRAPH 2017 [Seymour et al. 2017].

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