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Estimating emotions and tracking interest during movie watching, based on multimedia content and physiological responses

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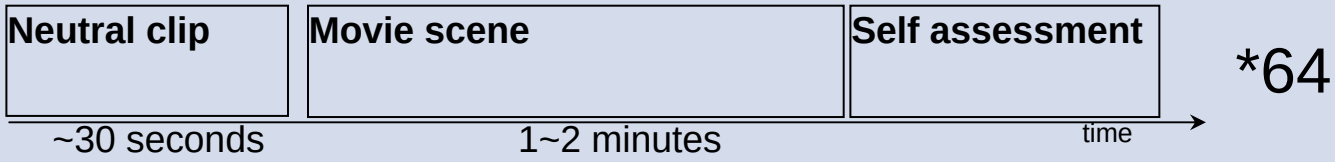
Why estimate emotions?

- Emotions reveal a persons true feelings in real-time
- In a video context, build a personal profile for video retrieval
- Physiological signals are (also real-time) related to these emotions

- Find correlated features
- Assessment of user behaviour and emotions
  - User's emotion prediction by arousal/valence levels from audio-video content analysis
  - User's emotional characterization by arousal/valence levels from physiological signals
- Assess interest levels

Video dataset

- In the experimental data set we have 8 movies from 4 different genres:
  - Horror: The Ring, 28 days later
  - Action: Kill Bill VOL I, Saving private Ryan
  - Drama: Hotel Rwanda, The Pianist
  - Comedy: Mr. Bean's Holiday, Love actually
- 8 short video clips were extracted from each movie
- A Neutral clip between each two video clips to record baseline and let the participant to return to neutral state
- Total duration ~2 hours



Multimedia content features

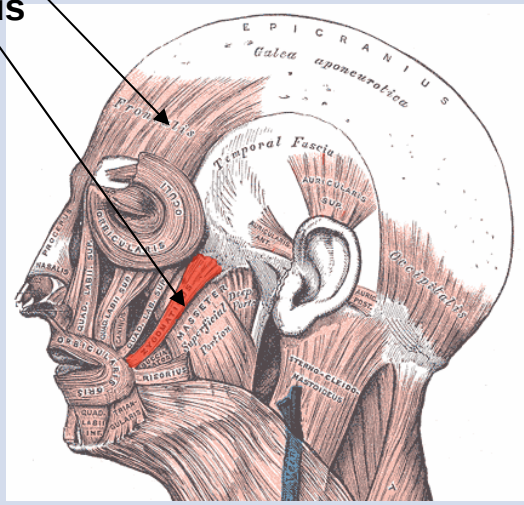
- All video content features are extracted with the help of OVAL and OMT software packages (*Viper*)
- Features extracted from multimedia content, namely:
  - Average shot duration
  - Shot change rate and variation
  - Color variance
  - Key lighting
  - Zero crossing rate (ZCR)
  - Audio energy
  - Audio type vector (music, speech, environment sound, and silence ratio over time)

Physiological feature extraction

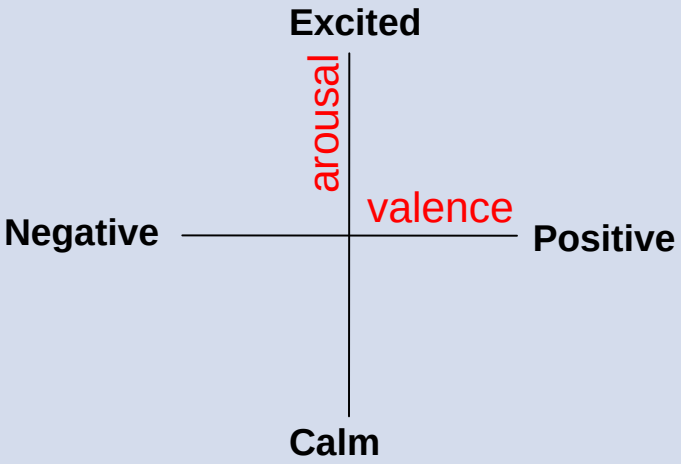
EMG	Power of Contraction
ECG	Heart Rate
	Heart Rate Variability
	Inter-Beat- Interval
Blinks	Blink Amplitude
	Blink Duration
	Blink Frequency
Plethysmograph	Heart Rate
	Heart Rate Variability
	Inter-Beat- Interval
Respiration	Respiration Depth
	Respiration Rate
GSR	GSR
	Number of peaks
	Peak amplitude
	dGSR/dt
Temperature	Temperature
	dTemp/dt

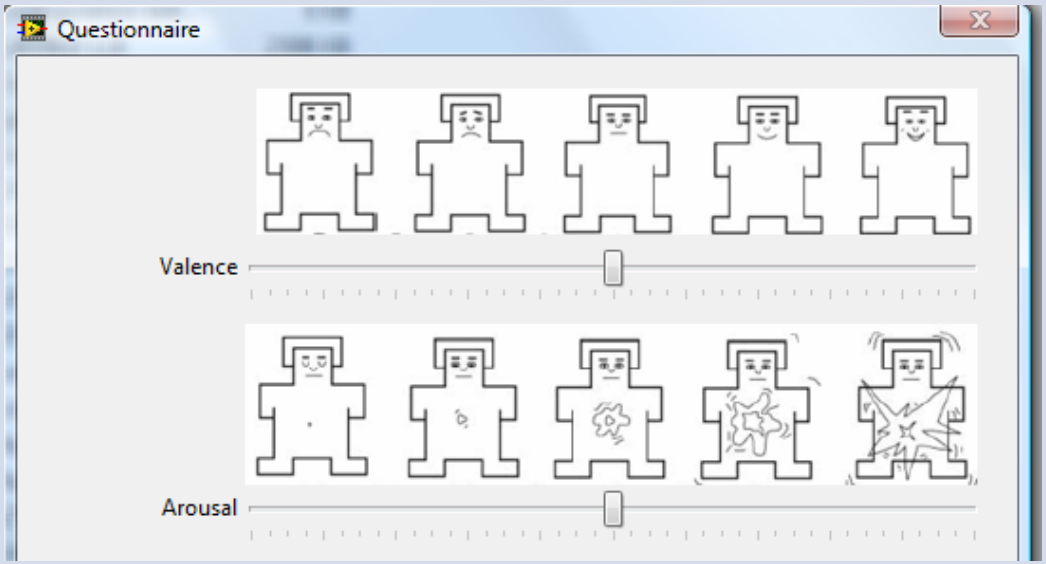
Frontalis

Zygomaticus



- Introducing the arousal valence space





Feature correlation

Correlation of selected multimedia features with physiological features of 8 participants				
	EMG Zygomatic. Energy/Key lighting	Skin temp.standard deviation /5th autocorrelation of MFCC coefficient	Skin temperature range/Shot length variation	EMG Zygomatic. energy/ 15th/20 bin of hue histogram
1	0.24	-	-	-0.41
2	0.62	0.44	0.42	-0.41
3	0.46	0.40	0.56	-0.34
4	0.40	0.32	0.43	-0.30
5	0.36	0.39	0.58	-
6	0.44	0.31	0.51	-0.32
7	0.47	0.34	0.27	-0.43
8	0.54	0.34	0.42	-0.45

Affect characterization

$$\begin{bmatrix} Y \end{bmatrix} = \begin{bmatrix} weights \end{bmatrix} \cdot \begin{bmatrix} feature - \\ values \end{bmatrix}$$

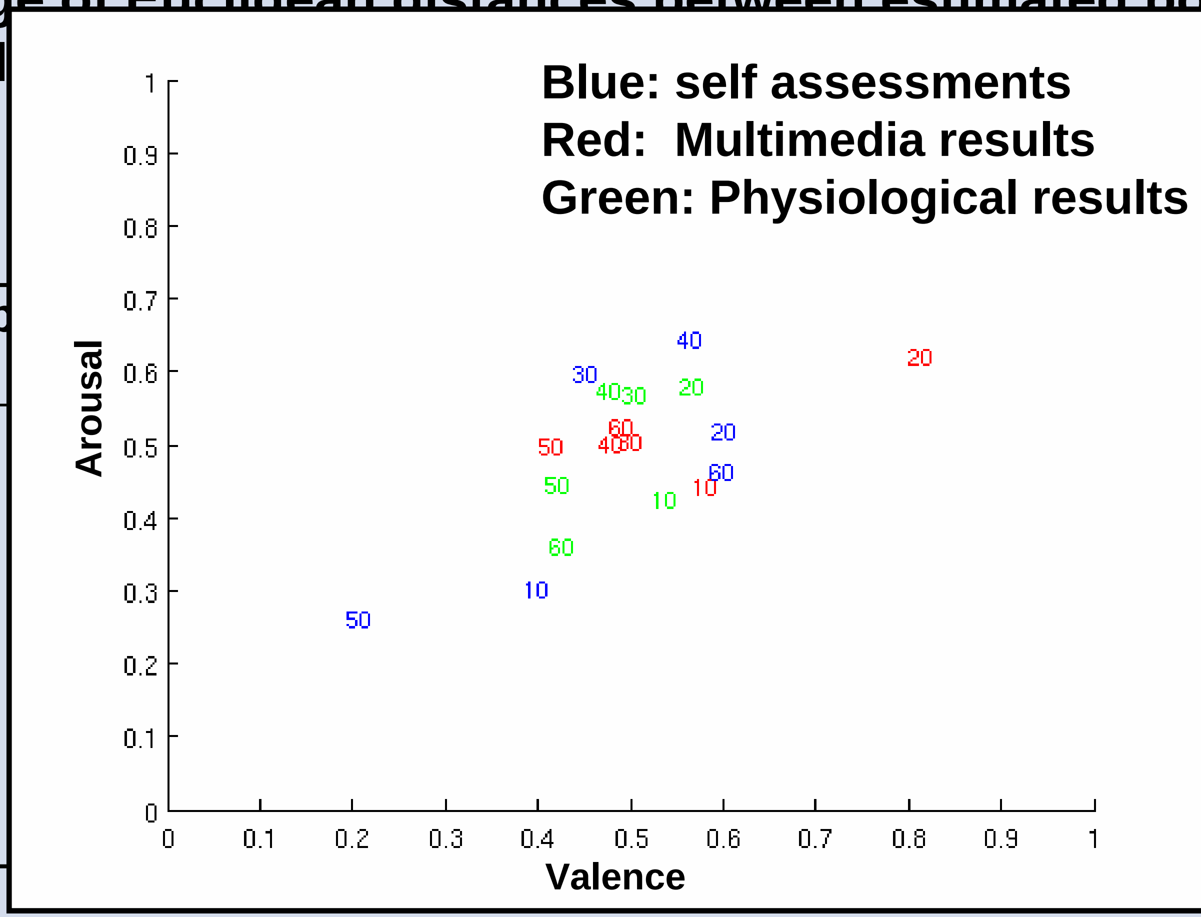
- *Y* can be either arousal or valence value, weights are trained. (RVM-lin.)
- Use computed weights to estimate arousal/valence scores (Tipping toolbox)
- Leave one out cross validation

$$\hat{y}(j) = \sum_i w_i x_i + w_0$$

i = feature number

j = movie scene number

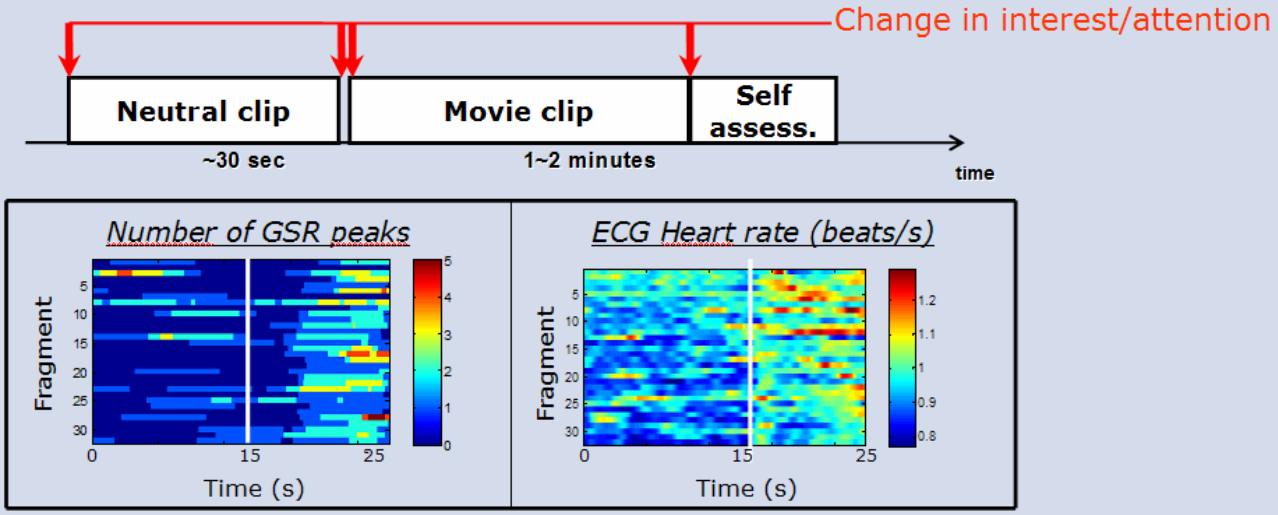
Average of Euclidean distances between estimated points and sel... for



Particip...	...nces with features
1	
2	
3	
4	
5	
6	
7	
8	

Interest detection

Need for training data containing relevant features for two levels of interest



LDA Classifier output: 72% accuracy on training data

Interest detection during movies

- Analyze full experiment
- Compare participants
- Evaluate

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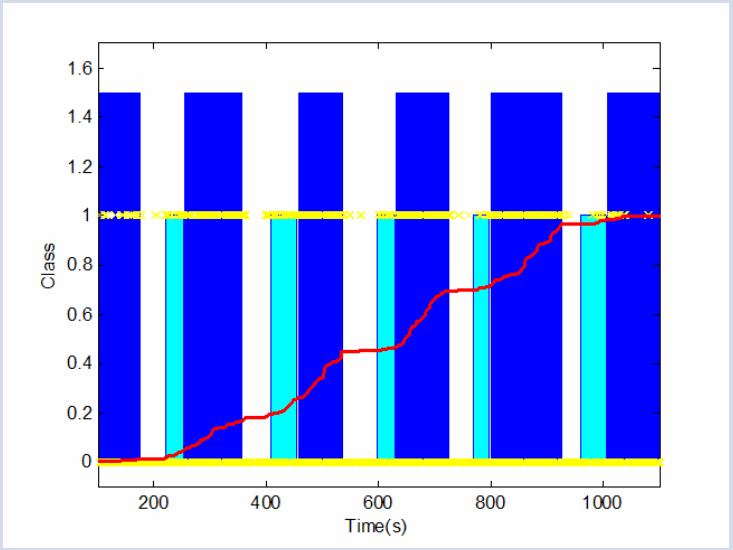

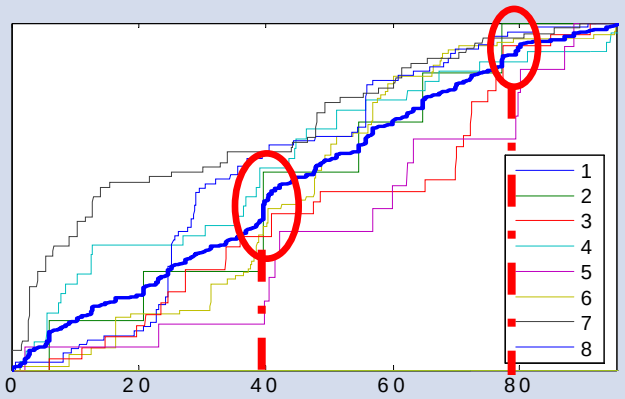

Conclusions

- The correlation between stimuli (multimedia) and response (physiological signals) was shown.
- Results show the ability of the physiological signals for affective characterization.
- Temporal detection of interesting movie fragments is feasible.

Future work

- Using prior information for affect estimation (genre, users rating, etc)
- Modeling and estimating dynamics of affect in movie watching by multimedia features.
- Implement other features (e.g., head movements from camera).
- Obtain objective measure for detecting interesting episodes instead of visual inspection.