
Observing Lip and Vertical Larynx Movements During Smiled Speech (and Laughter)

- work in progress -

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Outline

- Motivation
- Speech & laughter corpus
- 3D Motion Capture of the face
- ~~Image processing of the larynx region~~
- Sparse preliminary results

Previous Findings

- smiling in speech can be identified auditorily
- synthetic speech with raised larynx is identified as more smiled
- larynx lowering can compensate for reduced lip rounding
- conflict between reaching the *linguistic* requirements for rounded vowels and the *para-linguistic* signaling of smiling

Goal

- differences in lip rounding/spreading in neutral and smiled speech
- differences in vertical larynx position in neutral and smiled speech
- co-production of lip spreading/rounding and vertical larynx movements

Corpus

- controlled material
sustained isolated vowels [i: y: a: u:]
in each of three conditions:
 - i) neutral
 - ii) with slightly retracted mouth corners
 - iii) with maximally retracted mouth corners
+ swallowing + inhaling
- spontaneous material
 - laughter

3D Motion Capture

- Synchronous video recordings from different viewpoints (+ audio)
- Camera calibration
- Tracking of feature points over time
- Triangulation of 3D points from multiple 2D views

Experimental Setup



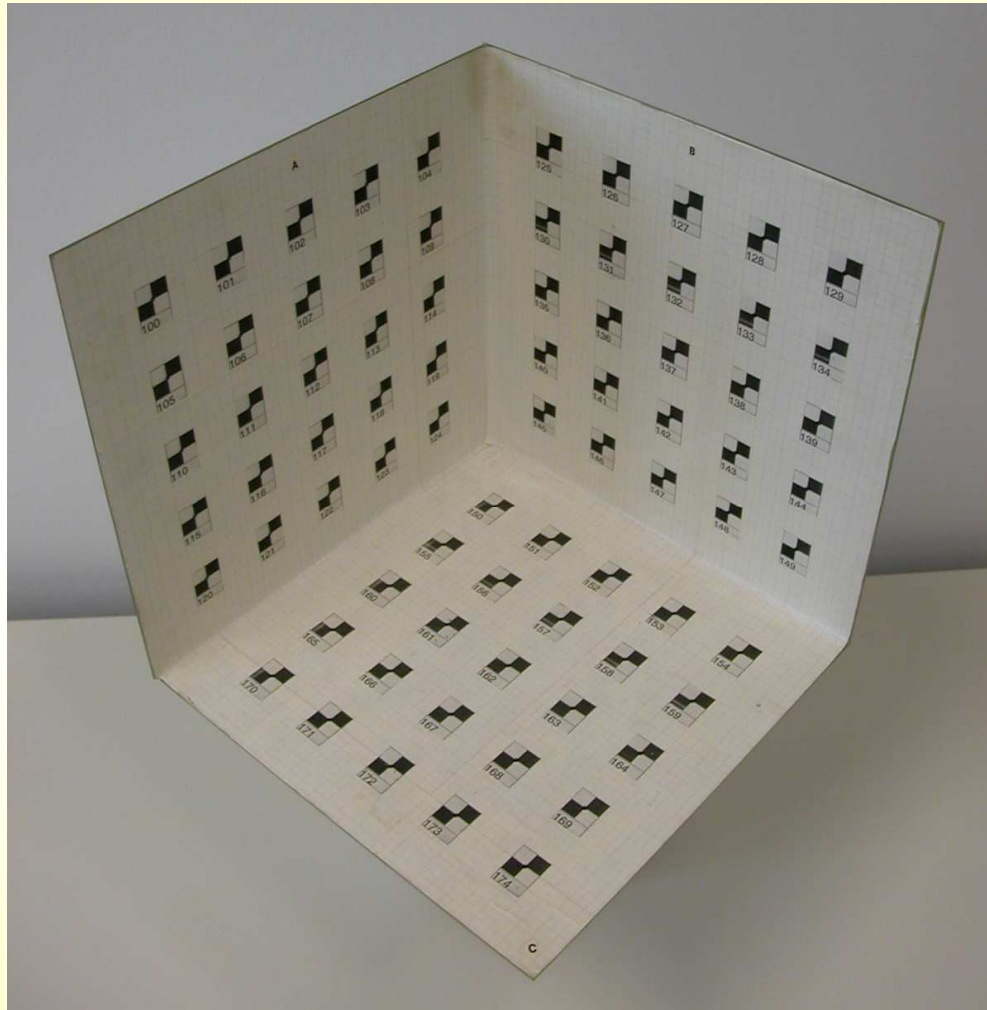
- Larynx region (1) with black background (2)
- left (3), center (4), right (5) view of the face

Multiple View Recordings

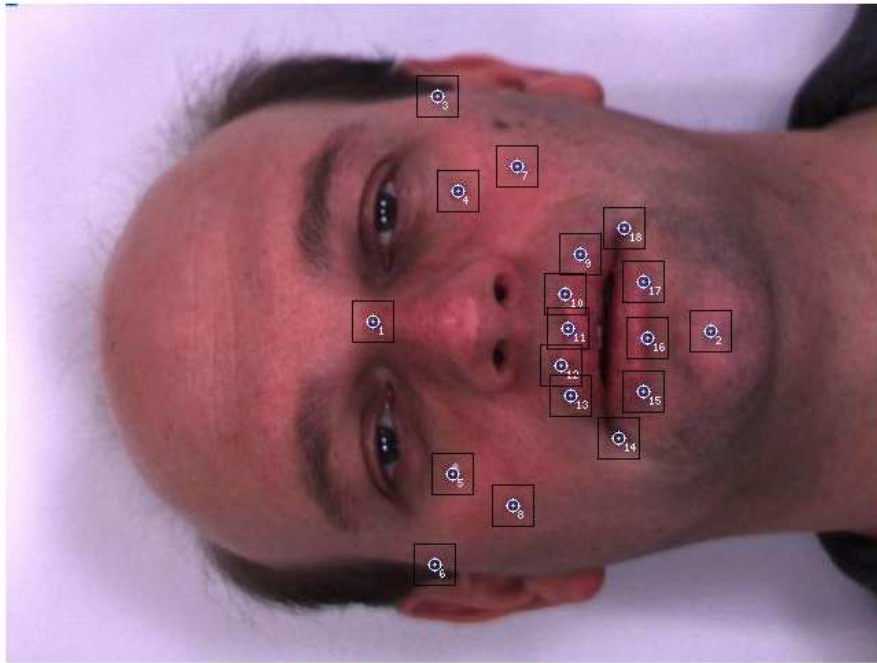


- 4 x DragonflyExpress (Point Grey Research)
- 30 (60) fps = 33 (17) ms per frame
- VGA resolution = 640x480 pixels full frame

Camera Calibration



- calibration object with known marker positions
- [system demo](#)



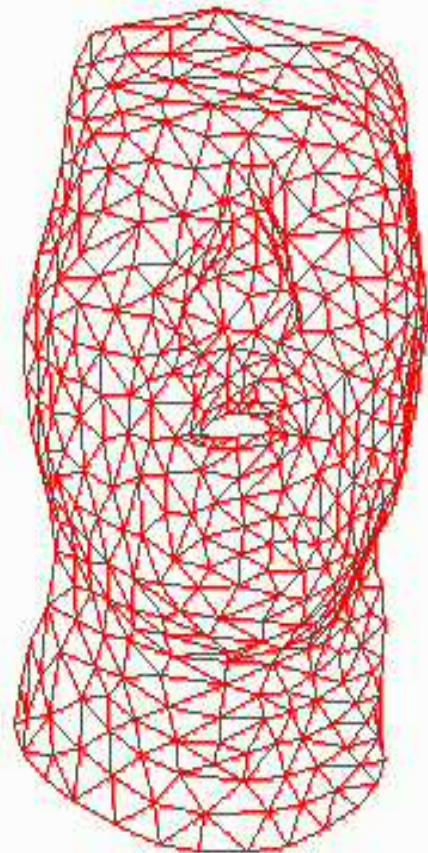
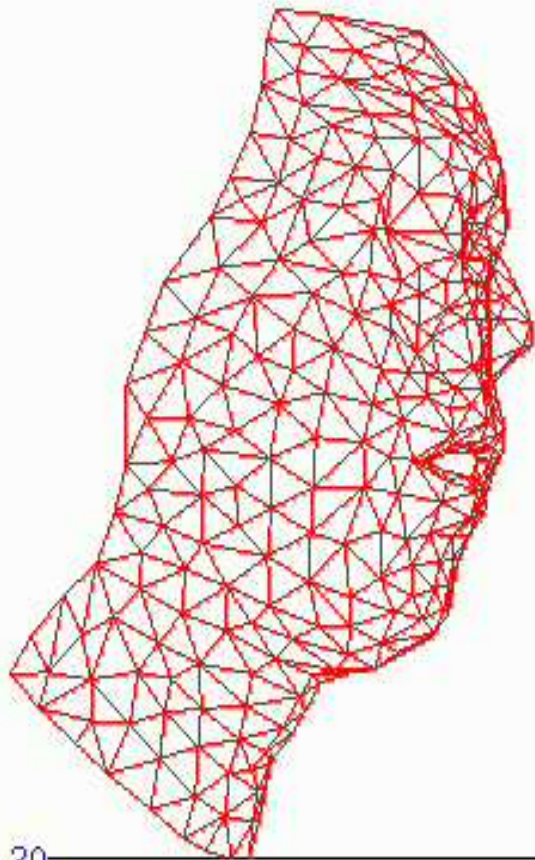
No.	X	Y	regionX	regionY	width
1	267	231	15	15	5
2	513	238	15	15	5
3	314	67	15	15	5
4	329	136	15	15	5
5	325	342	15	15	5
6	312	408	15	15	5
7	372	118	15	15	5
8	369	365	15	15	5
9	418	182	15	15	5
10	407	211	15	15	5
11	409	236	15	15	5
12	404	263	15	15	5
13	411	285	15	15	5
14	446	316	15	15	5
15	464	282	15	15	5
16	467	243	15	15	5
17	464	202	15	15	5
18	450	163	15	15	5

tracked0\camera0_0_tracked.jpg; set image position (0,0) [reset](#)

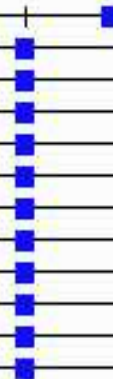
Calibration image:	C0F0	<input type="text" value="C0F0"/>	<input type="button" value="Durchsuchen..."/>	check camera No. manually
Base directory:	C:\images\			dir. set by calibration image
Reference image:	take0\camera0_0	<input type="text" value="take0\camera0_0"/>	<input type="button" value="Durchsuchen..."/>	use first image <input checked="" type="checkbox"/>
show image	<input type="radio"/> reference	<input type="radio"/> set marker	track from take 0 image 0	Calibrate camera 0!
	<input type="radio"/> tracked	action <input type="radio"/> clear marker	stop tracking!	Triangulation needs 2 cameras!
	<input type="radio"/> calibration <input type="radio"/> original	<input type="radio"/> set invisible	current take 0, image 25	Last camera No.?
Navigation			img 0 img 1> img 2>	img 5>
Go to image	image <input type="text" value="0"/>	take <input type="text" value="0"/>	camera <input type="text" value="0"/>	
Marker definition	region X <input type="text" value="15"/>	region Y <input type="text" value="15"/>	size <input type="text" value="5"/>	
<input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4 <input type="radio"/> 5 <input type="radio"/> 6 <input type="radio"/> 7 <input type="radio"/> 8 <input type="radio"/> 9 <input type="radio"/> 10 <input type="radio"/> 11 <input type="radio"/> 12 <input type="radio"/> 13 <input type="radio"/> 14 <input type="radio"/> 15 <input type="radio"/> 16 <input type="radio"/> 17 <input type="radio"/> 18 <input type="radio"/> 19 <input type="radio"/> 20 <input type="radio"/> 21 <input type="radio"/> 22 <input type="radio"/> 23 <input type="radio"/> 24 <input type="radio"/> 25 <input type="radio"/> 26 <input type="radio"/> 27 <input type="radio"/> 28 <input type="radio"/> 29 <input type="radio"/> 30 <input type="radio"/> 31 <input type="radio"/> 32 <input type="radio"/> 33 <input type="radio"/> 34 <input type="radio"/> 35 <input type="radio"/> 36 <input type="radio"/> 37 <input type="radio"/> 38 <input type="radio"/> 39 <input type="radio"/> 40 <input type="radio"/> 41 <input type="radio"/> 42 <input type="radio"/> 43 <input type="radio"/> 44 <input type="radio"/> 45 <input type="radio"/> 46 <input type="radio"/> 47 <input type="radio"/> 48 <input type="radio"/> 49 <input type="radio"/> 50 <input type="radio"/> 51 <input type="radio"/> 52 <input type="radio"/> 53 <input type="radio"/> 54 <input type="radio"/> 55 <input type="radio"/> 56 <input type="radio"/> 57 <input type="radio"/> 58 <input type="radio"/> 59 <input type="radio"/> 60 <input type="radio"/> 61 <input type="radio"/> 62 <input type="radio"/> 63 <input type="radio"/> 64 <input type="radio"/> 65 <input type="radio"/> 66 <input type="radio"/> 67 <input type="radio"/> 68 <input type="radio"/> 69 <input type="radio"/> 70 <input type="radio"/> 71 <input type="radio"/> 72 <input type="radio"/> 73 <input type="radio"/> 74 <input type="radio"/> 75 <input type="radio"/> 76 <input type="radio"/> 77 <input type="radio"/> 78 <input type="radio"/> 79 <input type="radio"/> 80				

Data analysis

- 3D reconstruction
- derived measures
- motion analysis
- statistical analysis

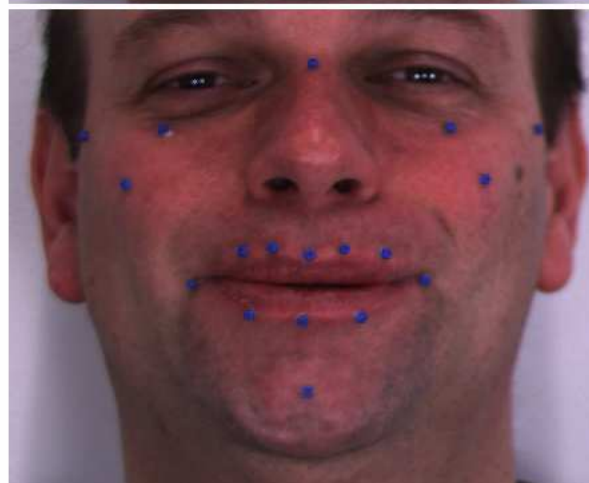
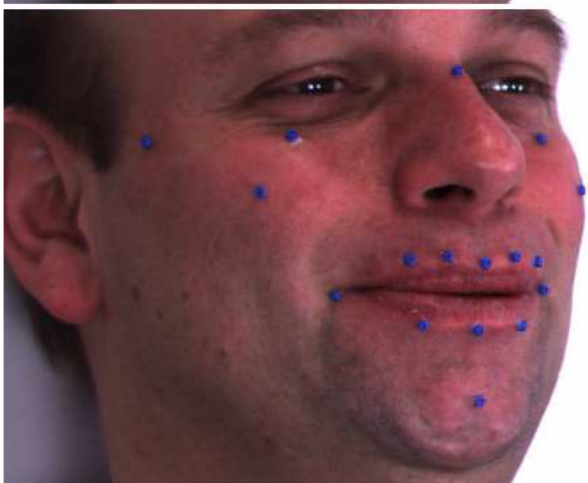
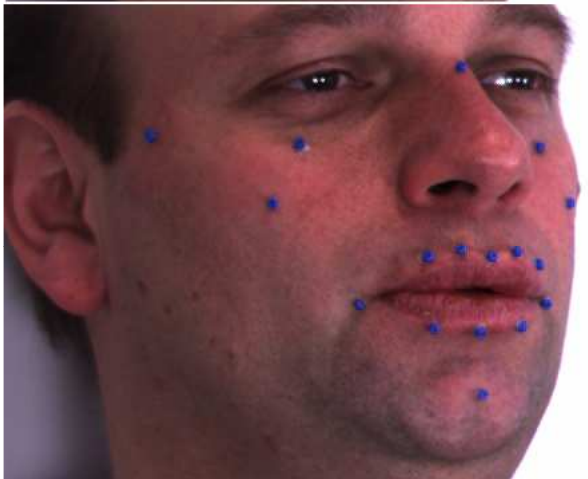
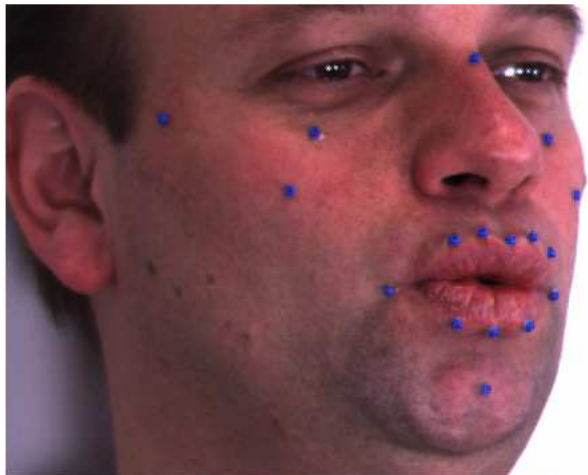


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Vertical Larynx Position





Sparse Preliminary Results

- Eyeballing - larynx:
 - Adam's apple not sufficiently visible
 - simultaneous head, thorax and larynx movements: What is vertical larynx position?
- Eyeballing - face:
 - less protrusion and more mouth corner retraction in rounded vowels during mechanical smiles
 - inner lip contour hardly predictable from outer lip contour
 - protrusion strategy changes with lip retraction

Future Work

- achieve final results
- spontaneous material
 - smiled speech
- speech with induced smile
 - interview method
- speech in interaction

