

POSTER PRESENTATION

Open Access

Neural model of biological motion recognition based on shading cues

Leonid A Fedorov*, Martin A Giese*

From 24th Annual Computational Neuroscience Meeting: CNS*2015
Prague, Czech Republic. 18-23 July 2015

Point-light or stick-figure biological motion stimuli, due to the absence of depth cues, can induce bistable perception, where the walker is perceived as heading in two alternating directions [1,2]. Psychophysical studies suggested an importance of depth cues for biological motion perception [3]. However, neural models of biological motion perception so far have focused on the processing of features that characterize the 2D structure and motion of the human body [4,5]. We extend such models for the processing of shading cues in order to analyze the three-dimensional structure of walkers from monocular stimuli.

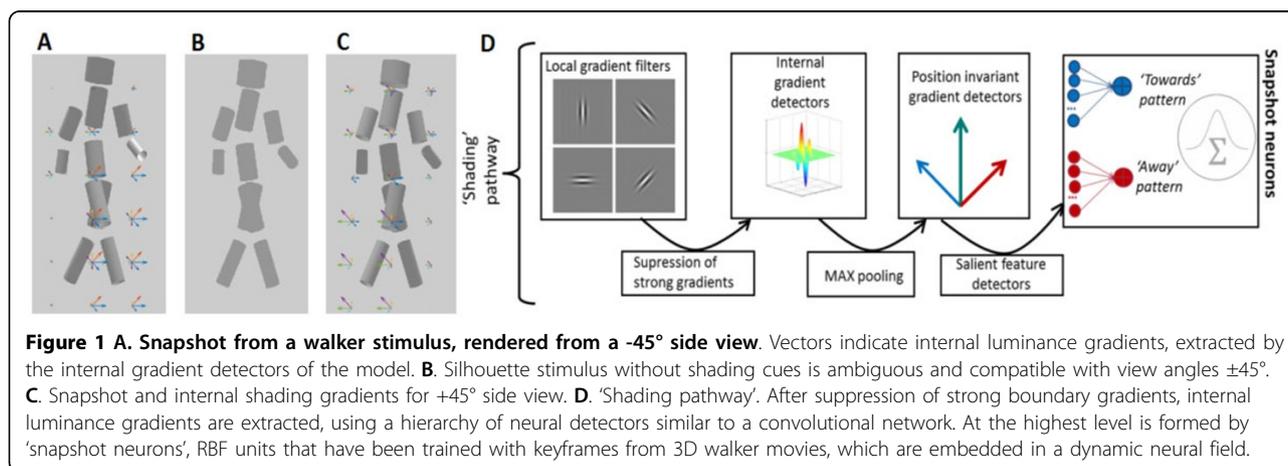
Model

As extension of a learning-based neural model [4], we add a 'shading pathway' that computes the internal contrast gradients that vary with the 3D view of the walker, even if the

silhouette information remains identical (Figure 1A-C). The model exploits physiologically plausible operations. After suppression of strong external luminance gradients caused by the boundaries of the silhouette, internal luminance gradient features are extracted by a hierarchy of neural detectors. These gradient features, combined with the shape features extracted by the form pathway of the model in [4], are used as input for 'snapshot neurons', RBF units that detect 3D body shapes (Figure 1D). These model neurons are embedded within a two-dimensional recurrent neural field [6] that jointly represents the sequential temporal structure of the stimulus and the view of the walker.

Results

The neural field dynamics reproduces perceptual multi-stability and spontaneous perceptual switching between



* Correspondence: leonid.fedorov@cin.uni-tuebingen.de; martin.giese@uni-tuebingen.de

Section f. Computational Sensomotrics, Dept. of Cogn. Neurology, CIN/ HIH, University Clinic Tuebingen, Tuebingen, Germany

stimulus views, observed for silhouette stimuli in psychophysical experiments [1,2]. It also reproduces the disambiguation by addition of shading information and a new perceptual illusion, which illustrates a lighting-from-above prior in the processing of biological motion stimuli.

Acknowledgements

Supported by EC FP7 ABC PITN-GA-011-290011, HBP FP7-604102, Koroibot FP7-611909, COGIMON H2020-644727, DFG GI 305/4-1, DFG GZ: KA 1258/15-1, and BMBF, FKZ: 01GQ1002A.

Published: 18 December 2015

References

1. Vanrie J, Dekeyser M, Verfaillie K: **Bistability and biasing effects in the perception of ambiguous point-light walkers.** *Perception* 2004, **33**:547-560.
2. Vangeneugden J, De Mazière P, Van Hulle M, Jaeggli T, Van Gool L, Vogels R: **Distinct mechanisms for coding of visual actions in macaque temporal cortex.** *J Neurosci* 2011, **31**(2):385-401.
3. Vanrie J, Verfaillie K: **Perceiving depth in point-light actions.** *Perc Psychophys* 2006, **68**(4):601-612.
4. Giese MA, Poggio T: **Neural mechanisms for the recognition of biological movements and action.** *Nat Rev Neurosci* 2003, **4**:179-192.
5. Lange J, Lappe M: **A model of biological motion perception from configural form cues.** *J Neurosci* 2006, **26**:2894-2906.
6. Amari S: **Dynamics of pattern formation in lateral inhibition type neural fields.** *Biol Cyber* 1977, **27**:77-87.

doi:10.1186/1471-2202-16-S1-P81

Cite this article as: Fedorov and Giese: Neural model of biological motion recognition based on shading cues. *BMC Neuroscience* 2015 **16**(Suppl 1):P81.

**Submit your next manuscript to BioMed Central
and take full advantage of:**

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

