Neurodynamical model for visual action recognition

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doi:10.12751/nncn.bc2014.0145

The recognition of body motion requires the temporal integration of information, which might be accomplished by recurrent networks that are composed from neurons with selectivity for body shapes in particular views [Giese2003]. The fact that body motion perception can be multi-stable [Vanrie2004] and shows adaptation [Jordan2006] suggests that such networks have non-trivial interesting dynamical properties. In order to study these properties mathematically, and as basis for the development of a unifying model for dynamic phenomena in action processing, we propose a neurodynamical model for action recognition.
Methods: The model is based on a two-dimensional neural field [Amari1977] that encodes body postures and their corresponding views. A lateral interaction kernel that is asymmetric in the posture dimension results in a competition between different stimulus views, and makes the field selective for the temporal order of stimulus frames in action movies. The model includes a Gaussian noise process and a linear adaptation dynamics for each point of the field. The adaptation dynamics was fitted quantitatively to electrophysiological data from area IT [deBaene2010].
Results: The model reproduces multistable perception for action stimuli that are consistent with multiple stimulus views [Vanrie2006]. It also accounts for the fact that repetition suppression effects in action-selective neurons are rather weak [Caggiano2013; Kilner2013].
The neural field predicts an interesting bifurcation dependent on the deviation of the rotation of a walker stimulus relative to the side view: for rotations angles below certain small degree the mutistablity of such stimuli should disappear, which is presently tested in psychophysical experiments.
Conclusions: The proposed model captures a number of dynamic phenomena in action perception which cannot be accounted for by the existing models. In addition, it provides an elegant mathematical framework for their analysis

Acknowledgements
EU projects ABC: PEOPLE-2011-ITN PITN-GA-011-290011; HBP: FP7-ICT-2013-FET-F/604102;
Koroibot FP7-ICT-2013-10/ 611909, and by DFG GI 305/4-1, DFG GZ: KA 1258/15-1, and BMBF,
FKZ: 01GQ1002A