The SOMMA model: cortically inspired maps for multimodal learning
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Aim:
- to learn correlations (meaning recurrent spatial patterns) from a multimodal data flow
- to generalize these correlations in order to adapt to unknown situations

Constraints:
- connectionist paradigm: computation is local, generic and decentralized
- learning is continuous and unsupervised

Means:
1) splitting of the data flow into multiple monomodal flows
2) self-organization of monomodal correlations in low dimension topology
3) reciprocal and topological connections between monomodal maps
4) learning of multimodal correlations by constrained monomodal self-organizations

Architecture:

Dynamics:
1) autonomous emergence of a representation of the current stimulus with a tabular coding in the sensitive layer
2) emergence of a monomodal perception in the perceptive layer
3) each perception influences the other ones via the cortical layer
4) resonance between maps converges to an unified multimodal perception

Model description:
- sensitive layer provides a tabular coding of the current stimulus
- cortical layer provides information from the other monomodal perceptions
- perceptive layer (dynamic neural fields) represents, by a spatial coding, the perception of the current stimulus as a consensus between the local (monomodal) and the multimodal activities

Learning description:
afferent weights:
- BCMu learning rule: discrimination of a correlation in the feedforward flow
- modulation by the perceptive activity combined with a synaptic regulation term: provides the multimodal self-organization of the discriminations

multimodal weights:
Widrow Hoff learning rule: the cortical activity converges on the perceptive one

Results:
The bidimensional localisation of each sensitive discriminated Gaussian is represented by the orientation and the color of the bar.
We can observe
1) the self-organization of the modal correlations in each modal map
2) as the same input is provided to both maps, the learning of multimodal correlations forces the modal self-organizations to be similar