# Dynamic Selectivity in a Continuous Attractor Model of Movement Generation

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The ability to discriminate between *self* and *others* movements is an important ability at the basis of our capacity to relate to others socially and to learn by imitation {Billard2002}. Current body of evidence suggests a common neural substrate to the recognition and production of movements in both humans and monkeys {Iacoboni1999, Rizzolatti2001}. A behavioral correlate of such discovery, related in several psychophysics experiments {e.g. Kilner2003}, is that observing movements of others influences the quality of one's performance. The observation of such an interference effect, while supporting the view of a common pathway for the transfer of visuo-motor information, calls for an explanation as to how the same substrate can both integrate multi-sensory information and determine, i.e. select, the origin of the observed movement.

Here, we show that such selective and integrative functions can be processed by a biologically plausible network composed of continuous attractor models. Indeed, such type of model, also known as neural fields, have been already studied at length by researchers addressing computational issues related to various brain regions concerned with, for instance, visual motion processing {Giese2000}, spatial navigation {Zhang1996, Xie2002} and decision making {Erlhagen2002}. We attempt to extend and merge the technical and conceptual contributions of these architectures in order to produce a model of movement generation, on which an external input related to the observation of movements of others will be added. As a result, both self's and others' representations will be merged into the same neural substrate, which may lead to competitive interactions and interferences.

The key ingredient of the discriminative mechanism that we propose relies *a)* on a recurrent network capable of updating its internal representation of movements through re-afferent motor copies, i.e. using an internal model, and *b)* on the winner-takes-all properties of neural fields. Therefore, when two ambiguous stimuli are presented to the network, i.e. have similar amplitude, the network dynamics will converge toward the stimulus that corresponds best to its generated internal model.

The full architecture of the model is depicted in Figure 1. It consists of two neural fields suggested to correspond to *a)* parietal and *b)* pre-motor cortical regions. Their respective task is to *a)* merge sensory information and transform hand target location into kinematic commands, and *b)* execute and integrate the given commands into its own internal representation. Similarly to neural sensitivities that were found in cortical motor areas, the internal representation of our neural fields (that are all identical for simplicity reasons) is grounded on a continuous set of neuron preferentially tuned to both position and direction of movements. The lateral weights follow typical combinations of symmetric and asymmetric connectivity {Zhang1996, Giese2000, Xie2002, Erlhagen2002}. Figures 2 and 3 illustrate the model dynamics, by showing the neural activity profiles and/or the external inputs. Moreover, the velocity profile measured on the motor fields is also shown. Figure 2: The model reaches the locations induced by the external input.

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Figure 3: Two ambiguous stimuli are presented to the network. Depending on the dynamics of the network's internal model, the stimulus corresponding best is selected.

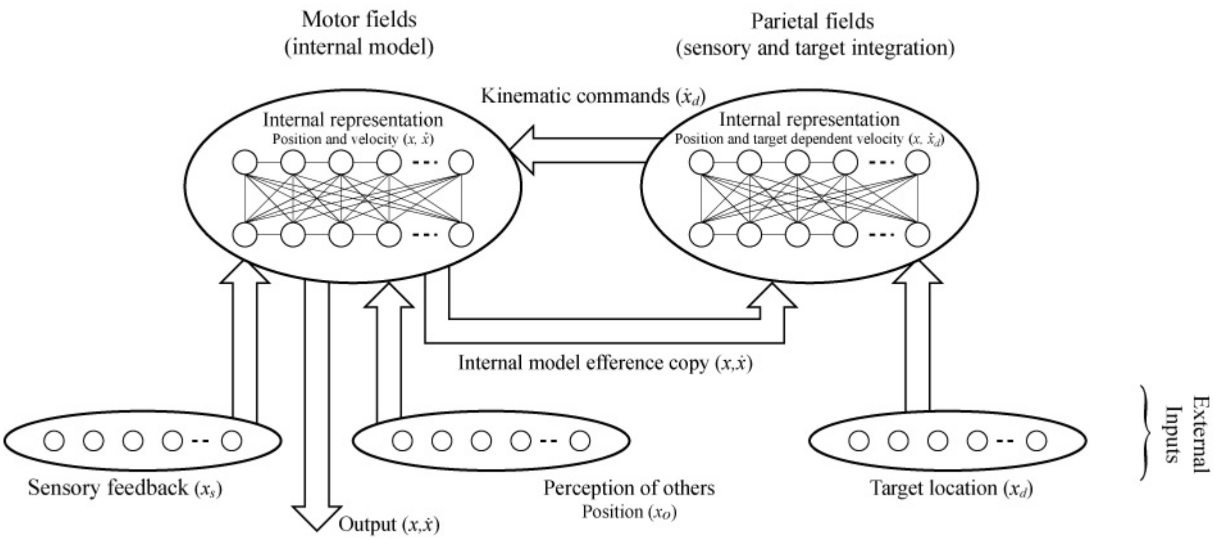


*Figure 1: Model's architecture*

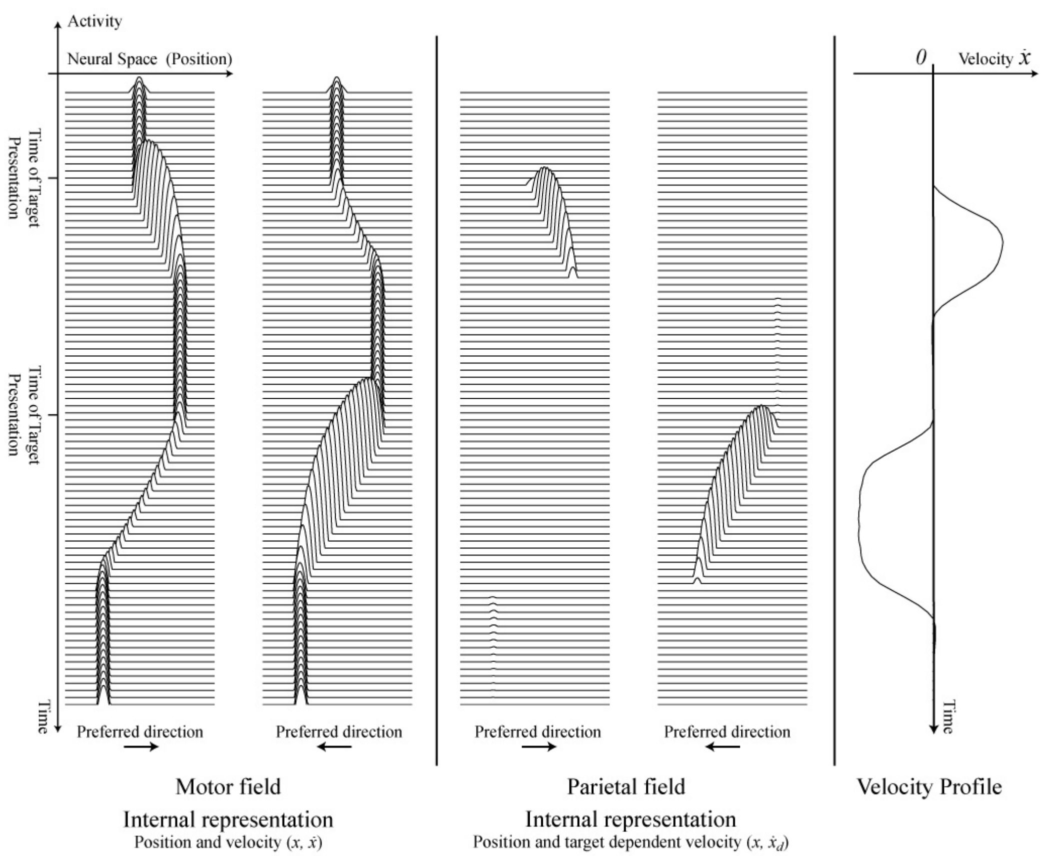


*Figure 2: Model's dynamics during point-to-point movements.*

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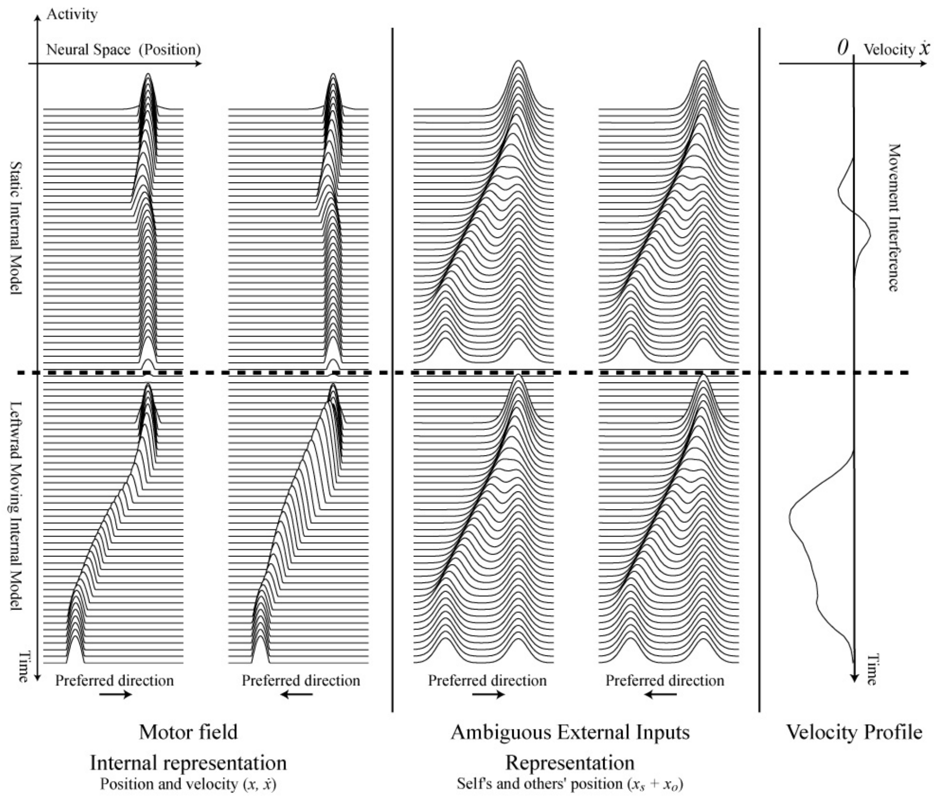


*Figure 3: Model's dynamical selectivity in case of ambiguous stimuli presentation.*

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