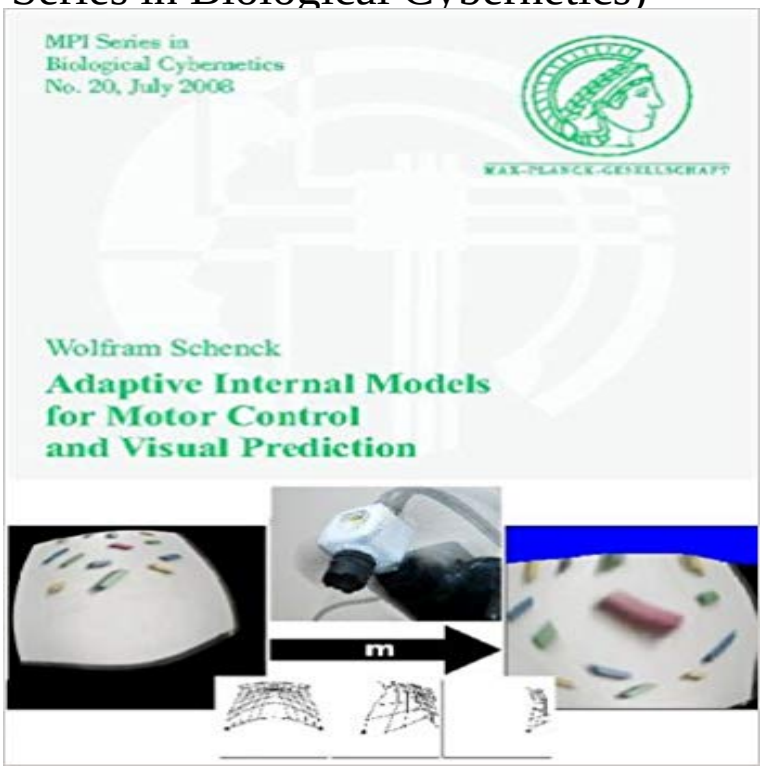
Adaptive Internal Models for Motor Control and Visual Prediction (Mpi Series in Biological Cybernetics)



In this thesis, computational models of adaptive motor control and visuomotor coordination are explored and developed. These models relate to hypotheses on how sensorimotor processing in biological organisms might be organized at an abstract level; furthermore, these models and their specific implementations offer solutions for technical problems in the domain of adaptive robotics. For this reason, both biological and technical aspects are addressed. On the one hand, this thesis focuses on the learning of so-called internal models (Miall et al., 1993; Kawato, 1999): forward models, which predict the sensory consequences of the agents own actions, and inverse models, which act like motor controllers and generate motor commands. In this area, new strategies and algorithms for learning are suggested and tested on both simulated and real-world robot setups. This work contributes to the understanding of the building blocks of integrated sensorimotor processing. On the other hand, this thesis suggests complex models of sensorimotor coordination: In a study on the grasping to extrafoveal targets with a robot arm, it is explored how forward and inverse models may interact, and a second study addresses the question how visual perception of space might arise from the learning of sensorimotor relationships. The theoretical part of the thesis starts with a close view on sensorimotor processing. The cognitivist approach and the embodied approach to sensorimotor processing are contrasted with each other, providing evidence from psychological and neurophysiological studies in favor of the latter. It is outlined how the application of robots fits into the embodied approach as research method. Furthermore, internal models are defined in a formal way, and an overview of their role in models of perception and cognition is provided, with a special emphasis on anticipation and predictive forward models.

Afterwards, a thorough overview of internal models in adaptive motor control (covering both kinematics and dynamics) and a novel learning strategy for kinematic control problems (learning by averaging) are presented. The experimental work comprises four different studies. First, a detailed comparison study of various motor learning strategies for kinematic problems is presented. The performance of feedback error learning (Kawato et al., 1987), distal supervised learning (Jordan and Rumelhart, 1992), and direct inverse modeling (e.g., Kuperstein, 1987) is directly compared on several learning tasks from the domain of eye and arm control (on simulated setups). Moreover, an improved version of direct inverse modeling on the basis of abstract recurrent networks and learning by averaging are included in the comparison.

The second study is dedicated to the learning of a visual forward model for a robot camera head. This forward model predicts the visual consequences of camera movements for all pixels of the camera image. The presented learning algorithm is able to overcome the two main difficulties of visual prediction: first, the high dimensionality of the input and output space, and second, the need to detect which part of the visual output is non-predictable. To demonstrate the robustness of the presented learning algorithm, the work is not carried out on plain camera images, but on distorted retinal images with a decreasing resolution towards the corners.

In the third experimental chapter, a model for grasping to extrafoveal (non-fixated) targets is presented. It is implemented on a robot setup, consisting of a camera head and a robot arm. This model is based on the premotor theory of attention (Rizzolatti et al., 1994) and adds one specific hypothesis: Attention shifts caused by saccade programming imply a prediction of the retinal foveal images after the saccade. For this purpose, the visual forward model from the preceding study is used. Based on this model, several grasping modes are compared; the obtained results are qualitatively congruent with the

performance that can be expected from human subjects. The fourth study is based on the theory that visual perception of space and shape is based on an internal simulation process which relies on forward models (Moeller, 1999). This theory is tested by synthetic modeling in the task domain of block pushing with a robot arm.

Adaptive Internal Models for Motor Control and Visual Prediction Kinematic Motor Learning . Adaptive Internal Models for Motor Control and Visual Prediction. W. Schenck MPI Series in Biological Cybernetics, 2008 **Goal Babbling: a New Concept for Early - Semantic Scholar** Adaptive Internal Models for Motor Control and Visual Prediction (Mpi Series in Biological Cybernetics) by Schenck, Wolfram (2008) Paperback on . **Adaptive Internal Models for Motor Control and Visual Prediction** Afterwards, a thorough overview of internal models in adaptive motor control (covering of visual prediction: first, the high dimensionality of the input and output space, Issue 20 of Mpi Series in Biological Cybernetics, Max-Planck-Institut fur **Adaptive Internal Models for Motor Control and Visual Prediction** Jun 6, 2016 Kinematic Motor Learning Adaptive Internal Models for Motor Control and Visual Prediction MPI Series in Biological Cybernetics, 2008 **Adaptive Internal Models for Motor Control and Visual Prediction** This thesis has been published in the MPI Series in Biological Cybernetics. (Logos Verlag, Berlin). ISBN: 978-3-8325-1899-8 **publications by wolfram schenck - FH Bielefeld** : Adaptive Internal Models for Motor Control and Visual Prediction (Mpi Series in Biological Cybernetics) (9783832518998): Wolfram Schenck: **Learning Strategies for Motor Control - AG Technische Informatik** Adaptive Internal Models for Motor Control and Visual Prediction (Mpi Series in Biological Cybernetics) by Schenck, Wolfram (2008) Paperback: Wolfram **Kinematic Motor Learning - Uni Bielefeld** MPI Series in Biological Cybernetics Adaptive Internal Models for Motor Control and Visual Prediction A Cybernetic Approach to Self-Motion Perception. **Adaptive Internal Models for Motor Control and Visual Prediction** (DOI: 10.3389/978-2-88945-065-7). Wolfram Schenck. Adaptive Internal Models for Motor Control and Visual Prediction. MPI. Series in Biological Cybernetics. Adaptive Internal Models for Motor Control and Visual Prediction. Schenck W (2008) MPI Series in Biological Cybernetics 20. Berlin: Logos Verlag. Download. **Eye-Arm Coordination - AG Technische Informatik - Universitat Adaptive Internal Models for Motor Control and Visual Prediction Mpi** Apr 12, 2012 Schenck, W. (2008). Adaptive Internal Models for Motor Control and Visual Prediction. MPI Series in Biological Cybernetics. Logos Verlag **MPI Series in Biological Cybernetics - Logos Verlag Berlin** cybernetics and adaptive robotics. Figure 2 Left: Forward model (the output is either a prediction of the . plants may require a series of motor commands {ut} to get from a state x0 to the In the literature regarding internal models and adaptive controller learning, . Thus, for the biological modeling of kinematic control,. **Space Perception through Visuokinesthetic Prediction - Uni Bielefeld** Dec 8, 2010 For a biological organism or an artificial agent like a robot, the ability to control its limbs and . Adaptive Internal Models for Motor Control and Visual Prediction. W. Schenck MPI

Series in Biological Cybernetics, 2008 **Biology - Logos Verlag Berlin** in: Anticipatory Behavior in Adaptive Learning Systems: ABIALS 2008 A model of visual space perception within the framework . sequences with motor commands mij are simulated by internal prediction (the W.: Adaptive Internal Models for Motor Control and Visual Prediction. MPI Series in Biological Cybernetics. **Robot Studies on SaccadeTriggered Visual Prediction - Uni Bielefeld** Adaptive Internal Models for Motor Control and Visual Prediction Mpi Series in Biological Cybernetics by Schenck, Wolfram 2008 Paperback: : **Publications by Wolfram Schenck - AG Technische Informatik** Dec 8, 2010 Adaptive Internal Models for Motor Control and Visual Prediction. W. Schenck MPI Series in Biological Cybernetics, 2008. Logos Verlag: Berlin **Adaptive Internal Models for Motor Control and Visual Prediction** Cognitive Science 32(3), 504542 (2008) Norman, J.: Two visual systems and two theories of perception: 675682 (2005) Schenck, W.: Adaptive Internal Models for Motor Control and Visual Prediction. MPI Series in Biological Cybernetics. **Adaptive Internal Models for Motor Control and Visual Prediction** Afterwards, a thorough overview of internal models in adaptive motor control (covering both kinematics and Series, MPI Series in Biological Cybernetics. **Adaptive Internal Models for Motor Control and Visual Prediction** Adaptive Internal Models for Motor Control and Visual Prediction 9783832518998 in Books, Magazines, Series Title, MPI Series in Biological Cybernetics. **Adaptive Internal Models for Motor Control and Visual Prediction** MPI Series hi Biological Cybernetics No. 20, July 2008 Wolfram Schenck Adaptive Internal Models for Motor Control and Visual Prediction Wolfram Schenck **Adaptive Internal Models for Motor Control and Visual Prediction** The boot- strapping of internal models without explicit prior-knowledge model for motor control, which selects one solution and applies it without more adaptive movements and error corrections by means of visual feedback [30]. Moreover, the earliest .. prediction, in MPI Series in Biological Cybernetics. Logos Verlag:. **Adaptive Internal Models for Motor Control and Visual Prediction** Adaptive Internal Models for Motor Control and Visual Prediction. MPI Series in Biological Cybernetics, Bd. 20. Wolfram Schenck ISBN 978-3-8325-1899-8 **Publications - AG Technische Informatik - Universitat Bielefeld** Afterwards, a thorough overview of internal models in adaptive motor control (covering both kinematics and Series, MPI Series in Biological Cybernetics. **Adaptive Internal Models for Motor Control and Visual Prediction** Adaptive Internal Models for Motor Control and Visual. Prediction. W. Schenck. MPI Series in Biological Cybernetics, 2008. Logos Verlag: Berlin. **Anticipatory Behavior in Adaptive Learning Systems: From - Google Books Result** Adaptive Internal Models for Motor Control and Visual Prediction (Mpi Series in Biological Cybernetics) by Schenck, Wolfram (2008) Paperback Pasta blanda **MPI Series in Biological Cybernetics: Adaptive Internal Models for** Find great deals for MPI Series in Biological Cybernetics: Adaptive Internal Models for Motor Control and Visual Prediction 20 by Wolfram Schenck (2008,