Abstract

The act of reaching out, grasping, and manipulating an object involves the integration of information from a variety of sources--from vision of the object of interest, to task requirements, to tactile and proprioceptive information as the grasp is executed. In this thesis, we investigate the cortical mechanisms involved in 1) the translation of a visual description of an object and a representation of the task into an appropriate hand configuration, and 2) the unfolding of this description in time in order to execute the preshape, enclose, grasp, and ungrasp phases of movement. On the basis of behavioral, cell recording, and anatomical data from human and monkey, a computational model of the grasping process is proposed. This model focuses on the roles of the intra-parietal areas (AIP, PIP, and VIP), inferior premotor cortex (F4 and F5), pre-SMA (F6), frontal cortex (area 46), inferiotemporal cortex (IT), and the secondary somatosensory cortex (SII).

In the model, AIP serves a dual role of first computing a *set of affordances* that are appropriate for the object being attended, and then maintaining an *active memory* of the single affordance as the corresponding grasp is executed. F5 integrates visual, task and memory information in order to select one of the several possible grasps. This brain region then drives the high-level execution of the grasp and monitors its progression. Based upon the hypothesized computational roles of AIP and F5, the model make several key predictions about the encoding of grasp and object information at both the single unit and population levels.

In addition, we present results of a PET (positron emission tomography) study that 1) compares brain activity during the performance of the precision and power grasps, and 2) examines the brain regions responsible for processing an abstract instruction stimulus. Through a

technique referred to as Synthetic PET Imaging, we are able to compare the human PET results to the global behavior of the model. We show that this technique can also be used to further constrain the model structure.