



**Title of Project : Integrative studies of neural mechanisms and advanced information technologies for perception of material and surface qualities**

**Term of Project : FY2010-2014**

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#### **【Purpose of the Research Project】**

We realize the richness of the real world through 'Shitsukan' perception, namely, perception of materials and surface qualities of natural and man-made objects. 'Shitsukan' also provides us with information which is vital in daily life. For instance, we use this information to identify objects and to judge their surface conditions such as friction to control grasping. 'Shitsukan' is also tightly related to preference / aversion or emotional reaction toward objects. Information for 'Shitsukan' perception is often given cross-modally by vision, touch and audition. However, little is known about what features contained in sensory stimuli are used for 'Shitsukan' perception. In vision, information related to 'Shitsukan' is embedded in a complicated high-dimensional manner in images generated through the interaction of surface reflectance, three-dimensional shape and illumination environment. We can effortlessly decipher such high-dimensional information, but how this can be achieved either theoretically or neurally is largely unknown. Similarly, how 'Shitsukan' is acquired or how it is used for various behaviors is not well understood. To understand these questions, cooperation among technology, psychophysics and neuroscience is very important. This project brings together expertise from these different fields to advance our knowledge on the mechanisms of human 'Shitsukan' perception and facilitate the progress of 'Shitsukan' technology science.

#### **【Content of the Research Project】**

This project consists of three groups: group A01 for engineering, B01 for psychophysics, and C01 for neuroscience. Group A01 develops technologies to systematically generate wide range of 'Shitsukan' stimuli and to faithfully reproduce 'Shitsukan' of objects employing the state-of-the-art theories and techniques of natural image processing, computer graphics (CG) and computational photography. This group also conducts research to develop novel algorithms to estimate factors such as object shape, surface reflectance and illumination from

images employing advanced techniques of inverse rendering. Group B01 conducts research to study what features contained in sensory stimuli are used for 'Shitsukan', and how learning or refinement of such perception is achieved. This group in collaboration with other groups will explore the possibility of quantitative measurement and computer recognition of 'Shitsukan', and techniques to control it. Group C01 conducts research to understand neural mechanisms of 'Shitsukan' employing various techniques of neuroscience on the basis of the information on the properties of 'Shitsukan' gained by the collaboration with other groups. This group studies how the information related to 'Shitsukan' is represented in various brain areas, and how it is related to recognition and emotional reaction.

#### **【Expected Research Achievements】**

This project will bring us deeper understanding of the neural processing of 'Shitsukan' information and how it affects emotion and how it is used for behavior. Understanding of heuristics and neural mechanisms of 'Shitsukan' will promote development of novel algorithm of 'Shitsukan' estimation that supports efficient CG rendering and compression of information regarding object appearance. This will enable more systematic measurement, manipulation and reproduction of 'Shitsukan' information. 'Shitsukan' is related not only to arts and crafts, but also to a wide range of industries because values of many commodities are closely related to their 'Shitsukan'. We believe that our project will contribute to a wide range of activities in our society.

#### **【Key Words】**

Shitsukan: A Japanese word to indicate perception of materials and surface qualities of objects as well as sensory impression of their fineness

#### **【Homepage Address】**

<http://shitsukan.jp/>