Identification of objects properties

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Trivially speaking, identification of the properties of an object is a part of the process of recognition of that object. It is useful to distinguish between recognition tasks that may be considered as spatially and topologically oriented and tasks that are physically-oriented (or dynamically oriented).

In spatially and topologically oriented tasks, we are interested in recognizing or identifying:

- Spatial features: macroscopic shapes, location.
- Topological features: number and structures of objects.

In physically-oriented tasks, conversely, we are interested in recognizing or identifying:

- The matter of the object. Although it seems to be just supplementary information, it requires in the context of multisensory simulation the rendering of completely different properties of the objects, and leads to quite different models, computational algorithms and machines for interaction.

Spatially and topologically oriented tasks have to be separated in two spatial scales: (1) macroscopic scale, and (2) microscopic scale.

A frontier exists today between these three types of implementations, putting a clearly-cut frontier in the tasks consisting in recognition of spatially-oriented macroscopic properties, recognition of physically-oriented properties and recognition of spatially-oriented microscopic properties, the second one being inserted between the two different spatial scales.

Consequently, the identification tasks can be split in three types of processes [Luciani et al., 2006], as explained in the following.

1) Object recognition and identification of *spatial and topological features* by means of exploration through *spatial action* (positioning) and exteroceptive channels.

It consists in a recognition task by means of sensory channels: audition (spatial features) and vision (spatial and topological features), associated to actions such as positioning action in a large meaning (displacing and displacements) i.e. with no possible modification of the dynamic state of the object. Here, 3D vision or 3D sounds may play a predominant role.

2) Object recognition and identification of *physical features* by means of exploration through *ergotic action* (squeezing, stretching, hitting, etc.) and proprioceptive and kinesthetic sensory channels.

Here, the identification process needs to interact with the matter to detect its rigidity, its fluentness, its weight, etc. that are more physical than geometrical properties. Visual, haptic and acoustical matter deformations may here play a predominant role, exhibiting all the scales of the behaviours of the physical object (visual scale, haptic scale, auditory scale) and revealing as well its dynamic properties as its geometrical and topological ones [→ Shapes and contours].

3) Object recognition and identification of *spatial features* by means of exploration by *tactile action* (palpating, brushing, skimming, etc.) and tactile sensory channels.

Continuing the traversing of the scales, for the recognition of the surface state (roughness, micro shapes as sharp edges, etc.), tactile exploration becomes the most important. The above strongly-in-hand situation can be relaxed. We are back to a recognition and exploration process similar to object non-closely-in-hand (case 1), though on a restricted and more precise spatial area.

Conclusion

This proposed three-scale is operational when seeking enabling object identification in the context of virtual reality and multisensory simulation. Indeed, depending on the level on which the designer wants the user to base object identification, or reciprocally on the level on which the user's task should be based, the system would have to render completely different properties of the objects, hence could needs fundamentally different models, computational algorithms and machines for interaction.

References

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