Zoom, haptic

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**Definition:**
A zoomable experience (see the item zoomable experience) is generally considered as visual. However, the use of sensory substitution devices (see the items related to sensory substitution) give us the possibility to experience in a given perceptual modality what is usually experienced in another.

In general, a zoom corresponds to a change in the resolution of an object. This can be represented as a window of constant size moving on a vertical axis of scales (Furnas and Bederson, 1995). If the object becomes small relative to the window, this corresponds to moving away; if the object becomes large relative to the window, this corresponds to a movement towards the object. It is the relation between the size of the image and the size of the window which defines the level of zoom; this can be expressed by the formula \( z = \frac{I}{F} \), where \( z \) is the level of zoom, \( I \) the size of the object, and \( F \) the size of the window.

On the basis of this formula, we can examine the situation when the size of the image remains constant, and it is the size of the window which changes. In this case, when the size of the window \( F \) increases, the level of zoom decreases; when the size of the window decreases, the level of zoom increases. Technically, this situation is functionally equivalent to the classic zoom.

The principle used for visual zoom can be used for haptic modality. Here we provide an example of use of the haptic zoom with a sensory substitution device named Tactos (Lenay et al., 2007). This device allows the display of 2D graphical objects by mean of the haptic modality. Tactos makes it possible to explore 2D graphical objects by moving a stylus on a graphic tablet. These displacements of the stylus command the displacement of a virtual window (or the matrix of receptor field) on the computer screen, and which give rise to a tactile stimulus (namely a dynamic pattern on Braille cells) if the receptor field encounters a 2D object on the screen. This “window” which moves on the screen can be compared to a virtual screen which moves over fixed numerical objects. By changing the size of this window, we can obtain the resolution and precision required. In haptic zoom, the change of the size of the “window” (i.e. receptive field) results in a different tactile pattern on Braille cells.

Thus, the smaller the size of the window/receptor field, the higher the resolution; the larger the size of the window, the lower the resolution and the (virtual) zoom. Technically, this corresponds to a change of scale. To obtain full functional equivalence with the classical form of zoom where it is the size of the object which changes, the movements of the stylus (and hence the movements of the receptive field on the computer screen) must be scaled down in strict proportion to the size of the window.

Different experimental situations have been implemented with this interface in order to define factors which encourage a zoomable perception through the haptic modality (for more details,
see Ziat et al., 2007). On one hand, these experiments helped us to better understand the constitution of a zoomable perception. A zoomable perception corresponds to an alternation of expansion and depth, when it is visual; and to either a real displacement on a surface or the displacement of an object relatively to another, when it is haptic.

On the other hand, they reinforce the idea that a prosthetic perception is submitted to the same laws than the others perceptual modalities. Perception by means of prosthesis is a new perceptual experience which can be constructed in the same way as the “natural” perceptual modalities.

To sum up, if the zoom is a perceptual experience often conceived as visual, it is possible to constitute this perception with haptic modality, notwithstanding the fact that the tactile is not favorable to the depth perception (see Haptic depth perception) in the real world (this sense requests the contact with the object).

In other words, the depth experience can be the subject of a true substitution within the framework of the interaction of the subjects with virtual objects.

References:
