# How visual stability is maintained in the face of the continual saccadic eye movements

Maria Concetta Morrone
Università Vita-Salute – S. Raffaele, Milan Italy

**March 20, 2006 at 15:00**

**Abstract:** A range of new techniques and a range of new concepts have opened the possibility of understanding the dynamics of perception: how we see the world in motion, how we see a stable world while continually scanning it with our eyes; and how we integrate visual input from one fixation to the next. I will illustrate some of the neuronal mechanisms that, by integrating visual signals over a time scale of seconds, mediate the transformation of the visual signal from retinotopic to spatiotopic coordinates and hence transaccadic integration (Melcher & Morrone, *Nat Neurosci, 6*, 877-881, 2003). I will also describe the dynamics of the transformation contingent with saccadic eye movements.

There is now considerable evidence that space is deformed when stimuli are flashed shortly before or after the onset of a saccadic eye movement (Ross, Morrone & Burr *Nature* 384, 598-601, 1997). New experiments show that not only is space grossly missperceived by saccades, but so too is time: the apparent temporal separation of two briefly-flashed bars is halved when they are presented near saccadic onset and perceived temporal order is consistently reversed (Morrone MC, Ross J, Burr D, *Nat Neurosci* 8:950-954, 2005). Taken together, the spatial and temporal phenomena accompanying saccades strongly suggest that vision may be subject to relativistic effects, similar to physical relativistic effects that occur at speeds approaching the speed of light. In many visual areas, neural receptive fields shift peri-saccadically to offset the effect of saccades. This dynamic coordinate transformation is rapid, approaching the physical limit of neural information transfer, hence producing relativistic consequences in both space and time. Transient stimuli captured during the dynamic coordinate transformation will be measured against spatial and temporal scales that are dilated by the Lorentz transform, and will therefore appear compressed in one spatial dimension and in time.

The concerted action of rapid receptive-field remapping and neuronal transaccadic integration may mediate the perceptual stability despite the continual eye movements.