Supplementary Videos to : Motion Clouds: Model-based stimulus synthesis of natural-like random textures for the study of motion perception

Paula Sanz Leon*[1,2], Ivo Vanzetta†[1,2], Guillaume S. Masson‡[1,2], and Laurent U. Perrinet§[1,2]

[1]INCM, CNRS / Aix-Marseille University, France
[2]Institut de Neurosciences de la Timone, CNRS / Aix-Marseille University, Marseille, France

*Paula.Sanz@univ-amu.fr
†Ivo.Vanzetta@univ-amu.fr
‡Guillaume.Masson@univ-amu.fr
§Corresponding Author, Laurent.Perrinet@univ-amu.fr

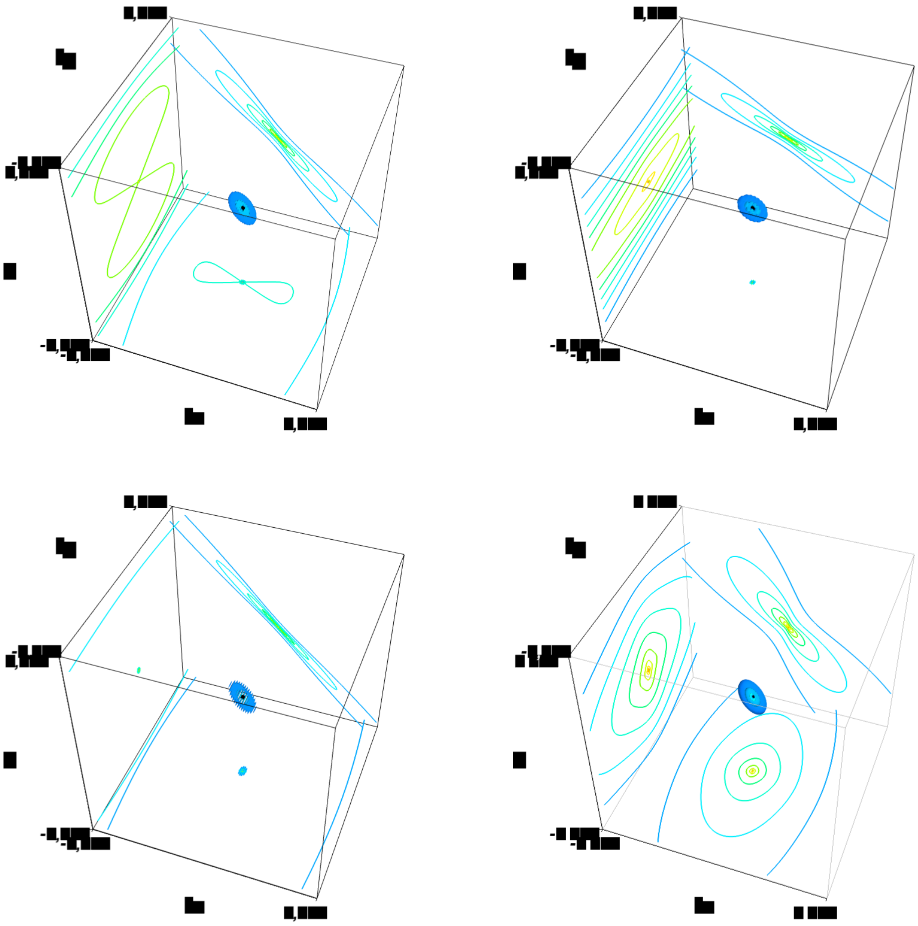

Figure 1: We show how speed is represented in the Fourier domain. The plane where most amplitude spectrum is concentrated and that goes through the origin is the speed plane. (Upper row): we present stimuli moving horizontally at two different speeds, $V_X = 1.0$ (left) and $V_X = 0.5$ (right). In this case, imagine that if we project the speed plane into the $f_x - f_t$ plane, the tilt ν of the line of intersection between both planes (and thus the tilt of the speed plane) changes as a function of V_X. In this way, observe that speed can be defined as $V_X = \tan(\nu) = {}^{f_t}/_{f_x}$. (Lower row): the variability of speed V is modeled as a Gaussian of bandwidth B_V in the frequency domain. Here, we illustrate two bandwidth values $B_V = 0.1$ (left) and $B_V = 0.5$ (right). The plane thickness also increases as a function of frequency.

Figure 2: Corresponding movies of the changes in the speed plane presented in Figure 1.

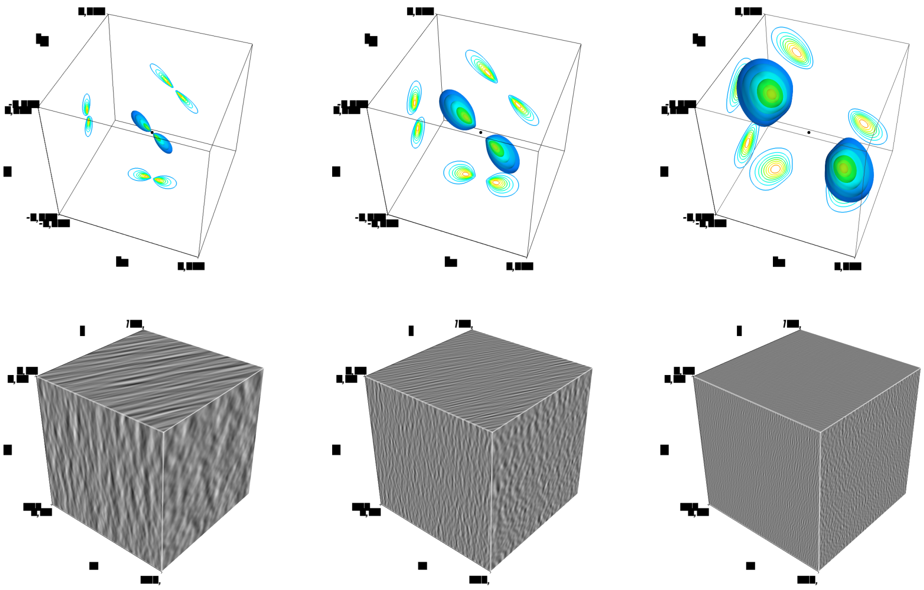

Figure 3: Spectra and stimulus cubes displaying the effect of different sf_0 values for a given selection of the speed plane. From right to left: increasing values of central spatial frequency. Not only the peak amplitude moves away from the origin but also the envelope spread widens from the definition of frequency bandwidth. From left to right, sf_0 values are 0.1, 0.2 and 0.4, while $B_sf = 0.2$. This stimuli are therefore simply scaled by the sf_0 parameter.

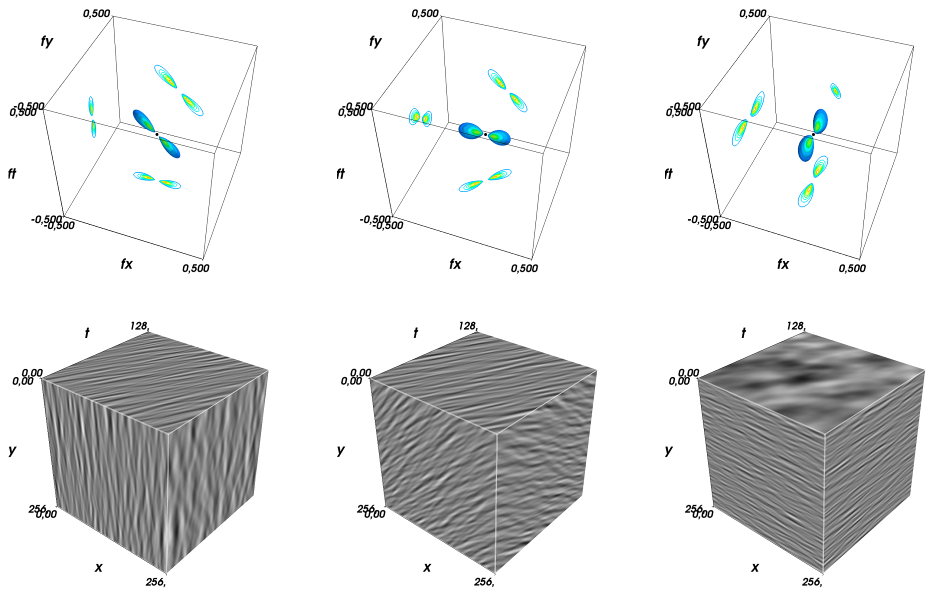

Figure 4: In this figure we illustrate the effect of parameter θ: the kernel preferred orientation. We show three differently oriented narrow-orientation-bandwidth Motion Clouds (respectively 0, $\pi/4$ and $\pi/2$ from left to right), both in the Fourier (upper row) and spatiotemporal (lower row) domains. Changes in the preferred orientation can be seen in the $x - y$ plane that corresponds to the spatial image domain, whereas in the frequency domain orientation is encoded by the relative position of the blobs with respect to the origin. Note that for $\theta = \pi/2$, the orientation is parallel to the direction, a situation that may lead to ambiguities in detecting motion similarly to the aperture problem.

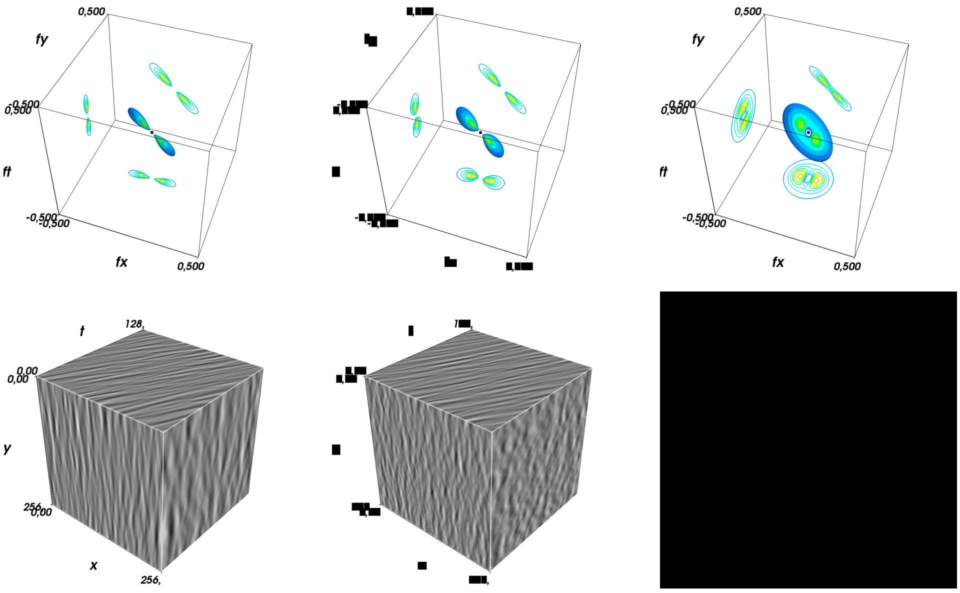

Figure 5: Motion Cloud stimuli with increasing B_θ from left to right. All stimuli have the same spatial frequency. On the left: a narrow orientation bandwidth stimulus ($B_\theta = \pi/13$). Its Fourier spectrum is two symmetric small aerofoil-shaped envelopes around the origin, concentrated in sf_0 and θ. Middle: an intermediate bandwidth $B_\theta = \pi/8$. On the right: A cloud stimulus has a large B_θ and oriented edges are lost ($B_\theta = \pi$). Its spectrum is disk-shaped as in Figure 3-right.

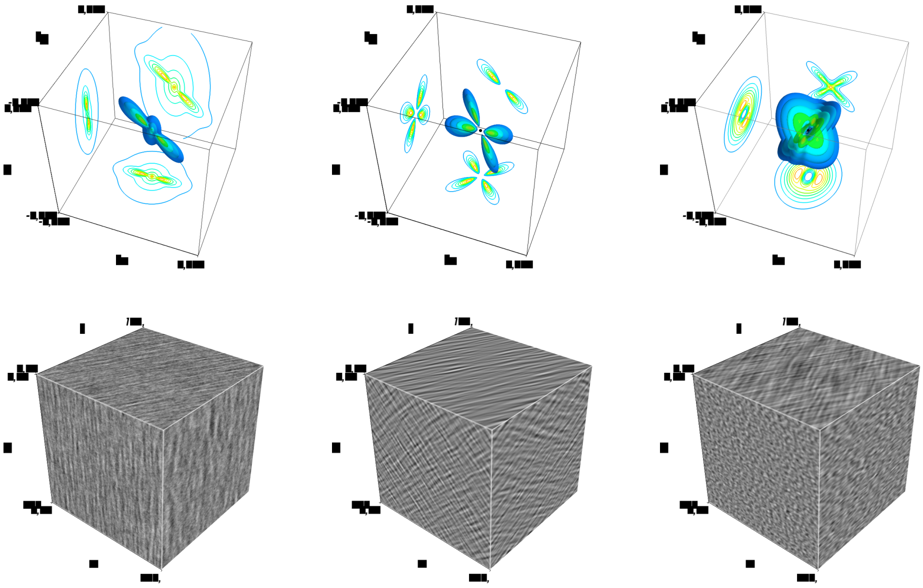

Figure 6: Competing Motion Clouds. (A): A narrow-orientation-bandwidth Motion Cloud with explicit noise. A red noise envelope was added to the global envelop of a Motion Cloud with a bandwidth in the orientation domain. (B): Two Motion Clouds with same motion but different preferred orientation were added together, yielding a plaid-like Motion Cloud texture. (C): Two Motion Clouds with opposite velocity directions were added, yielding a texture similar to a "counter-phase" grating. Note yet that the crossed shape in the $f_x - f_t$ plane is a signature of the opposite velocity directions, while two gratings with the same spatial frequency and in opposite directions would generate a flickering stimulus with energy concentrated on the f_t plane.