**Supporting Text**

**Detection of Jumps in Skew Profiles Using the Continuous Wavelet Transform (WT).** For effective detection of jumps or discontinuities, the simple intuitive idea is that these jumps are points of strong variation in the signal that can be detected as maxima of the modulus of the (regularized) first derivative of the signal. In order to avoid confusion between "true" maxima of the modulus and maxima induced by the presence of a noisy background, the rate of signal variation has to be estimated using a sufficiently large number of signal samples. This can be achieved using the continuous wavelet transform that provides a powerful framework for the estimation of signal variations over different length scales. The WT is a space-scale analysis that consists of expanding signals in terms of wavelets that are constructed from a single function, the analyzing wavelet, by means of dilations and translations (1, 2). When using the first derivative of the Gaussian function, namely, $g^{(1)}(x) = -\mathrm{d}g^{(0)}(x)/\mathrm{d}x$, with $g^{(0)}(x) = e^{-x^2/2}$, then the WT of the skew profile *S* takes the following expression:

$$T_{g^{(1)}}[S](x,a) = \frac{1}{a}\int_{-\infty}^{+\infty} S(y)g^{(1)}\left(\frac{y-x}{a}\right)dy = \frac{\mathrm{d}}{\mathrm{d}x}\, g_a^{(0)}{*}S\ (x,a)\ , \qquad [\mathbf{1}]$$

where *x* and *a* (>0) are the space and scale parameters, respectively. Eq. **1** shows that the WT computed with $g^{(1)}$ is the derivative of the signal *S* smoothened by a dilated version $g_a^{(0)}(x) = g^{(0)}(x/a)$ of the Gaussian function. This property is at the heart of various applications of the WT microscope as a very efficient multiscale singularity tracking technique (1, 2). The basic principle of the detection of jumps in the skew profiles with the WT is illustrated in Fig. 7. From Eq. **1**, it is obvious that at any fixed scale *a*, a large value of the modulus of the WT coefficient corresponds to a large value of the derivative of the skew profile smoothened at that scale. In particular, jumps manifest as local maxima of the WT modulus as illustrated for three different scales in Fig. 7 *Middle*. The main issue when dealing with noisy signals like the skew profile in Fig. 7 *Top* is to distinguish between the local WT modulus maxima (WTMM) associated with the jumps and those induced by the noise. In this respect, the freedom in the choice of the smoothing scale *a* is fundamental, because the noise amplitude is reduced when increasing the smoothing scale, whereas an isolated jump contributes equally at all scales. As shown in Fig. 7 *Bottom*, our methodology consists in computing the WT skeleton defined by the set of maxima lines obtained by connecting the WTMM across scales. Then, we select a scale *a* large enough to reduce the effect of the noise yet small enough to take into account the typical distance between jumps. The maxima lines that exist at that scale are likely to point to jump positions at small scale. The detected jump locations are estimated as the positions at scale 20 kbp of the so-selected maxima lines. According to Eq. **1**, upward (or downward) jumps are identified by the maxima lines corresponding to positive (or negative) values of the WT as illustrated in Fig. 7 *Bottom* by the black (or red) lines. For the considered fragment of human chromosome 12, we have thus identified seven upward and eight downward jumps. The amplitude of the WTMM actually measures the relative importance of the jumps compared to the overall signal. The black dots in Fig. 7 *Middle* correspond to the five WTMM of largest amplitude ($|\Delta S| \geq 12.5\%$); it is clear that the associated maxima lines point to the five major jumps in the skew profile. Note that these are five upward jumps with no downward counterpart and that they have been reported as five putative replication origins.


1. Arneodo, A., Audit, B., Decoster, N., Muzy, J. F. & Vaillant, C. (2002) in *The Science of Disaster* (Springer, Berlin), pp. 27-102.
2. Nicolay, S., Brodie of Brodie, E.-B., Touchon, M., d'Aubenton Carafa, Y., Thermes, C. & Arneodo, A. (2004) *Physica A* **342,** 270-280.