doi:10.1017/S1431927612008069
Microsc. Microanal. 18 (Suppl 2), 2012

RIMAPS Analysis of Filtered Images

Eduardo Favret [1,2] and Bárbara Pidal [1]

[1] Instituto Nacional de Tecnología Agropecuaria (INTA), CIRN. De Los Reseros y N. Repetto s/n. 1686 Hurlingham. Buenos Aires. Argentina.
[2] CONICET. Av. Rivadavia 1917. C1033AAJ. Ciudad de Buenos Aires. Argentina

RIMAPS (Rotated Image with Maximum Average Power Spectrum) technique detects the main directions of any surface topography [1]. During the last years it has been applied to the study of metallic and lithic surfaces and biological samples [2] [3]. This technique consists basically in performing the following steps: A) rotation of the original image from 0º to 180º; B) calculation of the x-step of the two-dimensional Fourier transform for each y-line of the new image obtained after rotation; C) computation of the average power spectra for each angular position and D) plotting of the maximum values of the power spectra as a function of the angle of rotation. This research work analyzes how RIMAPS spectrum varies when a filter is applied on the image of a leaf surface. The stylize filter from the Adobe Photoshop software program is used. This filter identifies the areas of the image with significant transitions and emphasizes the edges with dark lines against a white background and is useful for highlighting the borders of cells and papillae. We have studied the upper side of a fresh *Alstroemeria psittacina* Lehm. and *Nelumbo nucifera* Gaertn. leaves by using a variable pressure scanning electron microscope (VPSEM) with a magnification of 400x. Figure 1 shows the epidermis of the *Alstroemeria* leaf. Figure 2 shows figure 1 after using the stylize filter. The RIMAPS spectra of both figures indicate similar main directions of the surface pattern (see figure 3). However the RIMAPS spectrum of the filtered image (figure 3, red line) reveals better all the directions, specifically the three main directions of the leaf surface. The arrow 1 seen in figure 2 indicates the direction of the long side of the epidermic cell (160°), the arrows 2 (43°) and 3 (115°) point out the two directions of the waving cell walls. Figure 4 shows the leaf surface of *Nelumbo*. It has different cell morphology than *Alstroemeria.* Cells are more irregular and with papillae in its center. Figure 5 shows figure 4 after using the stylize filter. The papilla boundaries are clearly exposed in this image. The RIMAPS spectra of figures 4 and 5 indicate minimum differences between both. However the RIMAPS spectrum of the filtered image (figure 6, red line) reveals more clearly the principal directions of the papillae arrangement on the surface. The arrow seen in figure 5 shows the most important direction of the surface topography. In conclusion, images of two leaf surfaces with different topography were analyzed using a stylize filter. The RIMAPS spectra of the original and filtered images show no great differences as expected knowing how RIMAPS technique works [1]. However the RIMAPS spectrum of the filtered image reveals better the directions of the surface topography. The next step is to study more biological samples with different cell morphology and to find the range of application of RIMAPS technique on filtered images. RIMAPS spectrum is a useful tool for analyzing the angular distribution of the micro-nano-pattern quantitatively and determining the main characteristics of the pattern.

References

[1] N. O. Fuentes and E. A. Favret, *Journal of Microscopy*. 206 (2002) 72-83.
[2] E. A. Favret and B. Pidal, *Microscopy and Microanalysis*. 17 S2 (2011) 344-345.
[3] M. Alvarez et al, *Archaeological and Anthropological Sciences.* Springer. Published on line: 31-12-2011. 11 pages.

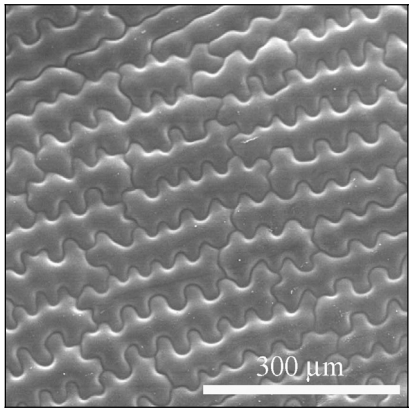

Figure 1. *Alstroemeria*: SEM image. 400x.

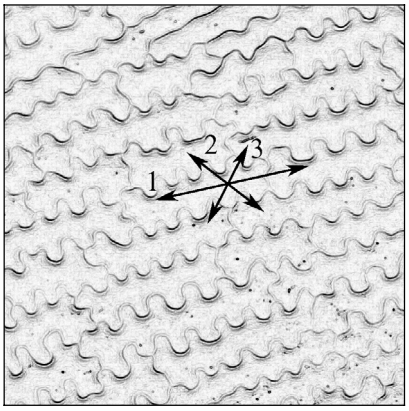

Figure 2. Fig. 1 with stylize filter

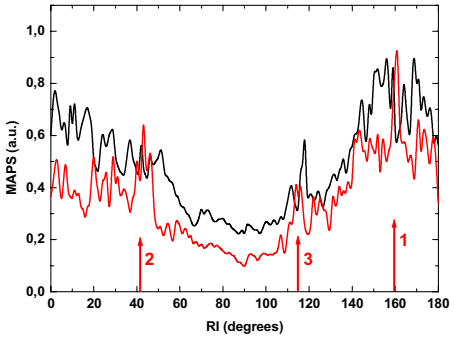

Figure 3. RIMAPS spectra of figs.1 (black line) and 2 (red line)

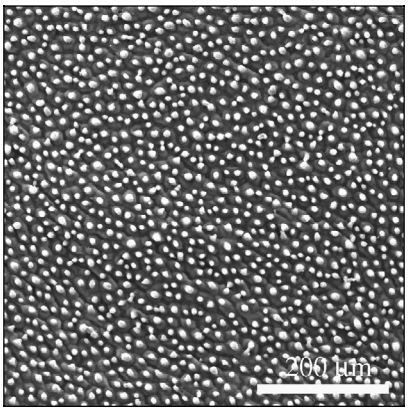

Figure 4. *Nelumbo*: SEM image. 400x.

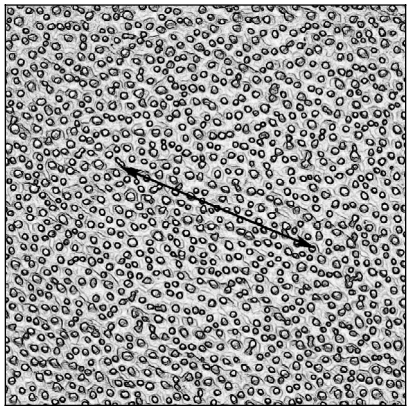

Figure 5. Fig. 4 with stylize filter

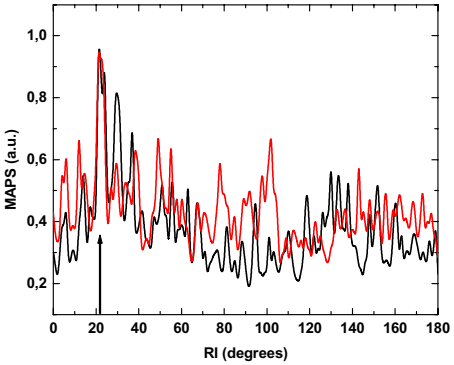

Figure 6. RIMAPS spectra of figs. 4 (black line) and 5 (red line)