



Digital image enhancement with *DStretch*[®]: Is complexity always necessary for efficiency?



Jean-Loïc Le Quellec^{a,*}, Frédérique Duquesnoy^b, Claudia Defrasne^{b,c}

^a IMAf, UMR 8171—CNRS/IRD/EHESS/Univ. Paris1/EPHE/Aix-Marseille Univ.—AMU, France/Honorary Fellow, School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Johannesburg 2050, South Africa

^b LAMPEA—UMR 7269, Aix-Marseille Université, France

^c Departament de Prehistòria, Història Antiga i Arqueologia—SERP Universitat de Barcelona, Spain

ARTICLE INFO

Article history:

Received 29 September 2014

Received in revised form

24 December 2014

Accepted 5 January 2015

Available online 24 January 2015

Keywords:

Rock art

Petroglyph

Prehistoric art

Image enhancement

Sahara

Tracing

Methodology

ABSTRACT

DStretch[®], plug-in for *ImageJ*[®] is designed specifically for the enhancement of digital images of pictographs. It is now widely used in the world since a decade but have thus far rarely been used in French and African rock art studies. Among all the software tools currently available to rock art specialists, it is one of the most efficient to decipher faint paintings and sometimes engravings, while being cheap, fast and easy to use, particularly in harsh or remote environments. Moreover, the enhancement of digital images with *DStretch*[®] is almost operator-independent and reproducible thanks to pre-recorded settings, thus improving objectivity. We provide several examples of the benefit of using this tool on various sites, from African prehistoric pictographs to Alpine paintings and petroglyphs, and propose a method for recording rock art panels with *DStretch*[®]. But, in spite of these advantages, we have to keep in mind that the final tracings are always subjective and biased by personal perceptions, as demonstrated here by a simple but significant experience.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Over the past 10 years, invention then development of digital photography and image enhancement software tools has significantly changed the recording and study of rock art (e.g.: Montero Ruiz et al., 1998; Kamal et al., 1999; Clogg and Díaz-Andreu, 2000; Brady, 2007; David et al., 2007; López-Montalvo and Domingo-Sanz, 2009; Gutiérrez Calvache and González Tendero, 2010; Rogerio-Candelara, 2010; Ortiz-Sanz et al., 2010; López-Montalvo, 2010; Rogerio-Candelara et al., 2011; Hollmann and Crause, 2011; Förster, 2013; Ruiz and Pereira, 2014). Compared to previous methodologies (hand sketch, direct tracing or tracing from film photography), the new tools constituting what Brady and Gunn call “the digital revolution” (Brady et al., 2012: 628) provide numerous advantages, like more comprehensive inventories of paintings (McNiven et al., 2004; Brady, 2006), more precise and objective tracings, and help for superimpositions studies (Gunn et al., 2010), while avoiding direct contact with pigments.

Image enhancement can be achieved at the photography step by using special technics as infrared (Fredlund and Sundstrom,

2007) or cross-polarization (Henderson, 2002), but the most commonly used method consists in post-processing the digital pictures through image enhancement software tools. Among those currently available, the “standard” one since more than ten years is *Adobe Photoshop*[®], a very powerful tool (Mark and Billo, 2002; Domingo Sanz and López-Montalvo, 2002; McNiven et al., 2004; Brady, 2006, 2007). Good alternatives are *ImageJ*[®] (written in java, open source, with a worldwide users community), and *Hypercube*[®] (a Spectral Imagery Analysis Software freely distributed by the US Army Topographic Engineering Center). However, *DStretch*[®], a free plug-in for *ImageJ*[®], designed specifically for the enhancement of digital images of pictographs by Jon Harman in 2005 (Harman, 2005; Mark and Billo, 2006) offers, at equal or often better performances, more advantages as regards ease of use, faster processing time, operator-independent enhancement.

We will not discuss here the technical aspects of *DStretch*[®] and its functioning, succinctly presented in a previous article (Le Quellec et al., 2013), as this topic was already discussed in detail by several specialists (Gillespie et al., 1986; Rothery, 1987; Gillespie, 1992; Alley, 1996; Guo and McM Moore, 1996; Harman, 2005). Now we would like to clarify the position we have currently reached in our reflections on the use of this software and on the fact that the final recording always involve a certain amount of subjectivity. We argue that the combined use of *DStretch*[®] and

* Corresponding author.

E-mail address: JLLQ@rupestre.on-rev.com (J.-L. Le Quellec).

Adobe Photoshop® at different steps of the procedure provides a very powerful toolbox for rock art studies, which may serve as a standard in this field.

2. *DStretch*®: operator-independent enhancement and efficiency in harsh environments

The main use of image enhancement software consists in helping visualization of faint paintings or of superimposed ones – or both – difficult to identify with the naked eye. As a wrong or partial inventory could lead to misinterpretation or overinterpretation of a figure or of a rock art site, deciphering painted motives is critical.

DStretch® is based on several algorithms first used in remote sensing and adapted for rock art studies by Jon Harman in 2005 (Harman, 2005). It was presented in France during the AAARS (Association des Amis de l'Art Rupestre Saharien) meeting in 2006, and the first French papers illustrated with photographs processed with this software appeared the following years (Dupuy and Fouilleux, 2007; Lachaud, 2008; Mastrucchi and Giannelli, 2008). AAARS is an association of Saharan rock art enthusiasts, and all AAARS authors are now routinely using *DStretch*®, which has enabled the discovery of hundreds of new pictures in the Sahara.

Curiously enough, outside this group, *DStretch*® is still rarely used in France and Africa, despite its undeniable qualities. For these parts of the world, this may be partly attributable to a long tradition of tracing techniques, going back to the Abbé Breuil era (Breuil, 1955: 16–18). In Southern Africa for example, many rock art specialists still favour direct tracings, although this technique raises conservation issues (but signs of change begin to appear: see Hollmann and Crause, 2011). French specialists working in caves have now improved their technique and work on photographs, checking their work by comparing it with the original at the site. They also use Computer Aided Drawing (CAD) but most of them are still reluctant to apply image-enhancement algorithms to their documents (Fritz and Tosello, 2007). In France, it seems that the first published paper using this method on a palaeolithic art image appeared in 2012 (Robert, 2011: Fig. 11) – and a second one was published in 2014 (Petrognani et al., 2014: 426) – while *DStretch*® is now routinely used in many other places of the World: Spain (Quesada Martínez, 2010; Fernández Ruiz and Spanedda, 2013; Martínez Collado et al., 2013; Collado and Julio García Arranz, 2013), Italia (Colella, 2010), Norway (Dodd, 2013), North America (Mark and Billo, 2006; Knight et al., 2010), Patagonia (Acevedo and Franco, 2012), Australia (Gunn et al., 2014), Cambodia (Tan et al., 2014), etc. *DStretch*® has also proved to be a very suitable non-destructive tool to study the morphology of the ceramic cracks of the glazed ceramics of the Song Dynasty (Lahlil and Ji Ming, 2013).

One of the main advantages of this plug-in is that the enhancements are almost fully operator-independent while for most of the other software, they depend on the operator's skills and expertise level and thus vary enormously. This ensures reproducible and more objective results, which is essential for an accurate study of the art (Clogg and Díaz-Andreu, 2000: 842; Brady et al., 2012: 630, 632). Presettings design leads to a quick and easy learning of the plug-in as well as to rapid results, when handling different settings or combination of settings with *Photoshop*® or other software takes, in average, more time. And *DStretch*® yields faster or often better results, as illustrated in the coming examples.

Ease and rapidity in obtaining powerful and reliable results are crucial in documenting rock art sites, above all in remote areas and harsh environments, desert or mountainous regions where access difficulties and fieldwork logistics are critical aspects. When it

is impossible to go back and forth between the site and the laboratory, *DStretch*® allows a fast on-site deciphering of the walls, helping to rapidly acquire a comprehensive and accurate documentation, even with limited material and financial resources.

It should be stressed that *DStretch*® has to be considered as a possible and even essential tool for recording petroglyphs, at least in some contexts and when the research question does not require 3D models. This software yielded convincing results in the southern French Alps, in the Oullas rock-shelter (St-Paul-sur-Ubaye, Alpes-de-Haute-Provence), a rock surface painted and engraved from the Neolithic period (Defrasne, 2014). On-going studies show that *DStretch*® is even indispensable in this area. One of the main goals of the new recording techniques is to avoid any contact with the rock surfaces, but in the Alps some panels are covered with tangled fine and superficial linear incisions. Such engravings could be revealed thanks to an almost horizontal light, a technique particularly suitable for working in closed environments (Robin, 2010), but high in the mountain (as in desert areas) we have a very bright context and no power source, and recording these lines from photographs would be quite difficult and rather risky. Fortunately, *DStretch*® proved to be very efficient there. Linear incisions were highlighted and could be easily recorded in a complete and detailed way (Figs. 1 and 2) – an impossible task with *Photoshop*®. At the Oullas rockshelter, only this way made it possible to detect medieval or modern linear engravings which can be very difficult to see with the naked eye (Figs. 3 and 4).

2.1. On-site deciphering with *DStretch*®

To ensure high quality and affordable on-site documentation even when circumstances are unfavourable, we propose a two-step procedure.

- (1) The completion of a systematic photographic coverage of the entire wall, without prejudging the existence of paintings. Each photograph covers about $1 \times 1 \text{ m}^2$, with at least 50% of overlap in order to avoid missing any figure. An alternative solution could be the use of the *GigaPan*® robotic system to automatically generate a panorama (Mark and Billo, 2011). In 2012, one of us (JLLQ) had the opportunity to test this system in two sites of the Libyan Desert (cf. Le Quellec and De Flers, 2013; Kuper, 2013): the “Cave of the Hands” (<http://gigapan.com/gigapans/118768>) and the “Cave of the Beasts” (<http://gigapan.com/gigapans/118911>), confirming that it is fast and easy to implement even in the most difficult environments. Pictures are then immediately enhanced in situ with *DStretch*®. Each identified motif (even partial ones) is given by

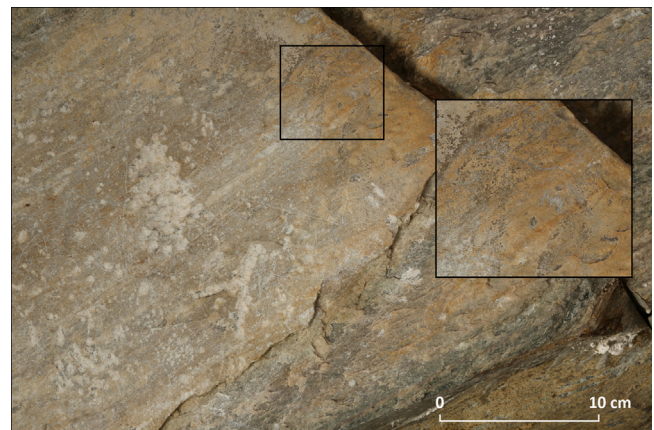


Fig. 1. Superficial linear incisions at the Oullas rockshelter (Saint-Paul-sur-Ubaye, Alpes-de-Haute-Provence, France) (Photograph: Claudia Defrasne).

Download English Version:

<https://daneshyari.com/en/article/108039>

Download Persian Version:

<https://daneshyari.com/article/108039>

[Daneshyari.com](https://daneshyari.com)