Individual recognition software application in Project Lemur Frog (www.lemurfrog.org)

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Background to I3S

Interactive Individual Identification System (I^{3}S) (den Hartog and Reijns, 2016) is software developed to non-invasively aid often-laborious and time-consuming recognition processes necessary in many studies. While other methods of identification involve implanting elastomers or toe-clipping, this software is based on comparing natural markings and features that are unique to individuals. Such identification is necessary for several types of studies, including common garden laboratory experiments and capture-recapture studies, such as in Project Lemur Frog. The software, of which there are six releases, has been used successfully on a range of taxa, including sharks (van Tienhoven *et al*., 2007) and geckos (Rocha *et al*., 2013). The most recent release, I^{3}S Pattern$^+$ was designed specifically for amphibians. Here, I^{3}S Pattern$^+$ was tested on a captive *A. lemur* population and produced positive results. Various methods were trialled to create a standardised, yet practically realistic, protocol for gathering data in the field. We conclude that I^{3}S Pattern$^+$ will be a valuable tool in Project Lemur Frog, and its use will show progress towards the adoption of non-invasive techniques in research.

Using I^{3}S Pattern$^+$

Photographs are taken of every individual captured and databases are created by manually inputting these. The process consists of three steps. First, two reference points are chosen. These are consistent points on all individuals, allowing correction for rotation and scale during comparisons. Next, an area of interest is manually highlighted (see fig. 1). For the last stage of input, the user defines the background and foreground colours within the area of interest (see fig. 1). These vary over the entirety of an individual's back. As long as these are all defined properly by the user, I^{3}S Pattern$^+$ can separate the pattern correctly (see fig. 1). The user is not required to pick out each individual marking, aiding time-efficiency.

Once the databases are complete, comparisons can be made to identify any recaptures. The software transforms the 3D images into 2D patterns based on the manual input. By overlapping the patterns, the individuals can be compared (see fig. 2). I^{3}S Pattern$^+$ produces a ranked list of possible matches, where the best match is first. The user makes the final decision on the correct match.

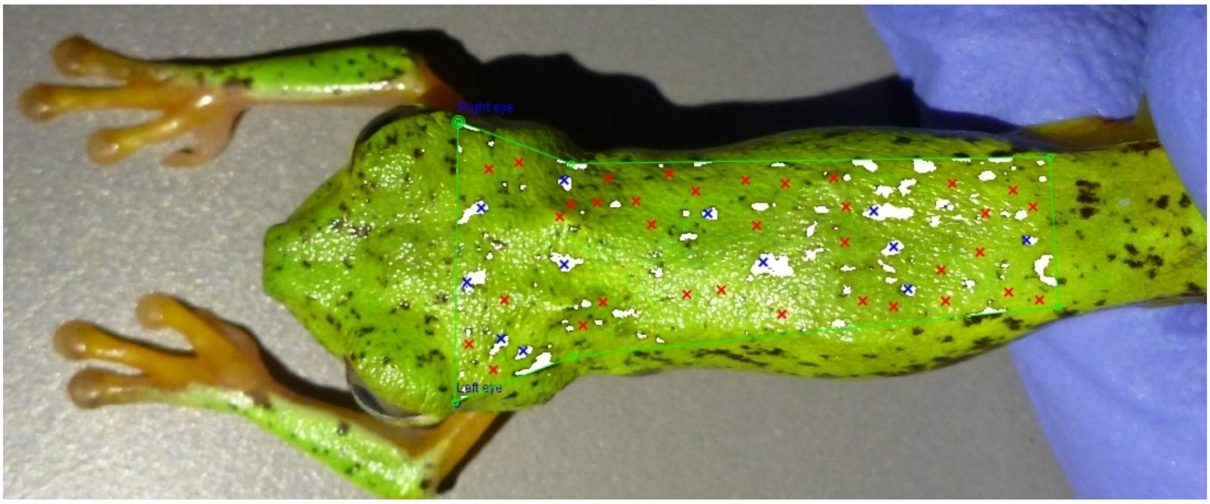

Figure 1. Screenshot of photograph input*. The green lines denote the area of interest. Red crosses define where user selected the background colours; blue crosses indicate the foreground. White patches are the pattern that I3S has correctly picked out. (Figure adapted from I^{3}S Pattern$^+$ software).*

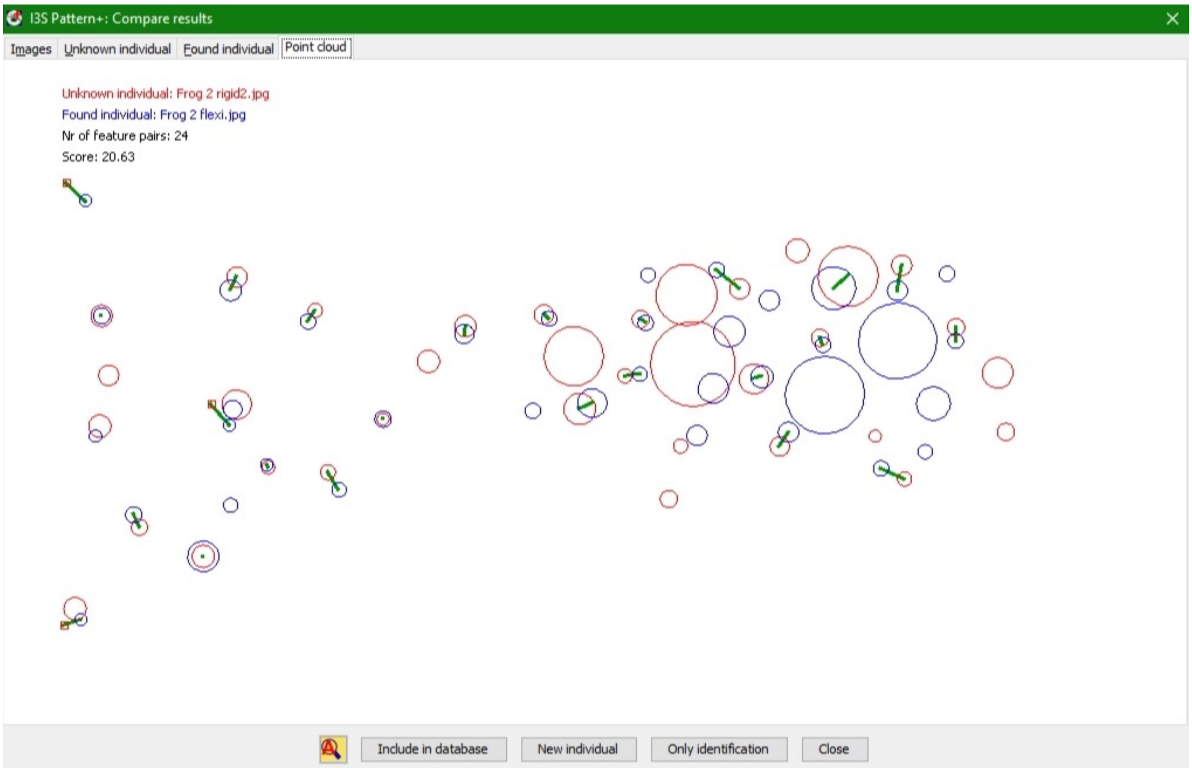

Figure 2. Screenshot of 2D pattern comparison by I3S Pattern+. *Circles in red describe the pattern of the unknown individual; blue circles define the same individual, but using a different photograph. The green lines indicate features of both patterns that were identified by the software as the same. (Figure adapted from I^{3}S Pattern$^+$ software).*

Taking the photographs

The software is reliant on the quality of the images, both in resolution and content. It is crucial that the camera lens is perpendicular to the dorsal surface of the frog, as in fig. 1. Lighting is also important, affecting pattern recognition by the software. Poor lighting can create shadows, while using the camera's flash creates too much flashback, both obscuring the markings. In the vivarium, the best approach involved resting a torch on a shelf (or the closest substitute in the field), facing downwards. This allowed better control over lighting to minimise shadows and flashback. It also left two hands free to hold the frog steady (using the method shown in fig. 1) and take photographs. The most suitable background material was found to be one which is durable and light, yet rigid, that can be wiped and creates little flashback (seen in fig. 1).

Identification results

The software was trialled using frogs before and after changing colour. Two groups were used, one consisting of 13 individuals and the other, five. I^{3}S Pattern$^+$ had a 100% match success rate, but rankings differed. We firstly compared individuals when all were in light colour states; these photographs were taken before the methodology was standardised. Of those, 75% were ranked first. After the photography standardisation, individuals in dark colour states were compared, during which 98% of the matches were ranked first. Comparisons that included both colour states produced matches in which only 45% were ranked first (although most of the remainders were ranked between second and fifth). This lower rate was likely because markings not visible during the light state are emphasised in the dark state. As all field surveys will be carried out at night, this is not foreseen to be a problem.

References

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