Igor Holländer, Ivan Bajla, Markus Minichmayr, Günter Gmeiner, Christian Reichel

GASepo: Project Summary 2004–2006

Austrian Research Centers GmbH – ARC, A-2444 Seibersdorf, Austria

Introduction

Since the development of an analytical method for the direct detection of the application of recombinant erythropoietin in urine samples by Lasne et. al. (Nature, 2000, 405, 635), much effort has been devoted in order to implement the method in different laboratories and to standardize and harmonize the interpretation of the data obtained by isoelectric focusing, double blotting and chemiluminescence detection. The use of different software products with different tools of data interpretation interfered the search for a common basis of gel interpretation.

Austrian Research Centers is an R&D institution with a rich record of multidisciplinary projects. Among other research and scientific branches, it also includes an accredited Doping Control Lab (DCL) and an IT department, nowadays known as *smart-systems*. These two expert teams have been collaborating successfully since a couple of years on development of a software for quantitative analysis of electrophoretic images.

ARC Seibersdorf research prepared a proposal for an international project aimed at development of a professional, reliable and easy-to-use software package specially tailored for quantification of epo gel images. The proposal was submitted to World Anti-Doping Agency which approved it as a three-years project, 2004–2006.

The Most Important Innovative Ideas Implemented in GASepo

2D Image Analysis

Unlike other 1D gel analysis software, GASepo is based on a two-dimensional philosophy. Images are 2D entities in nature, so the analysis restricted to a 1D profile means information loss. In GASepo, all relevant information from the image is used.

Band Segmentation and Classification

The bands representing epo isoform are detected as 2D image objects by a sophisticated segmentation and classification (=object identification) algorithms (Bajla et al, 2005, Štolc et al, 2006). Once the contours of the bands are obtained, the properties of the bands such as height, volume etc, are calculated.

Novel Background Correction

The background correction in GASepo takes into account that the acquired image signal is additively composed of the useful part and the 'base surface'. Reduction of this surface to a single curve means loss of detection limit. In a study (Reichel et al, 2006) we indeed showed that the method is superior to the valley-to-valley integration, as it performs with extremely high robustness leading to no exposure time dependency.

Results

User Survey

According to a user survey carried out in February 2007, out of 34 WADA-accredited laboratories worldwide, 24 are doing EPO analysis. Out of this number, 23 (96 %) are using GASepo for image analysis. Out of these laboratories, 8 (35 %) laboratories are using GASepo exclusively, 7 (30 %) are using GASepo as the primary analysis software (i.e., the use any other software only in special cases or for comparison).

The Most Recent Release

The project has been concluded by release of the Version 1.3 of the software package. The newly added features include options for inter-lane comparison in 2D profile curves as well as in a 3D view, and an envelope curve plot enabling easy assessment of the most prominent isoforms.

The most recent release can be downloaded from the URL:

www.antidoping.at/gasepo

(ask authors for access credentials).

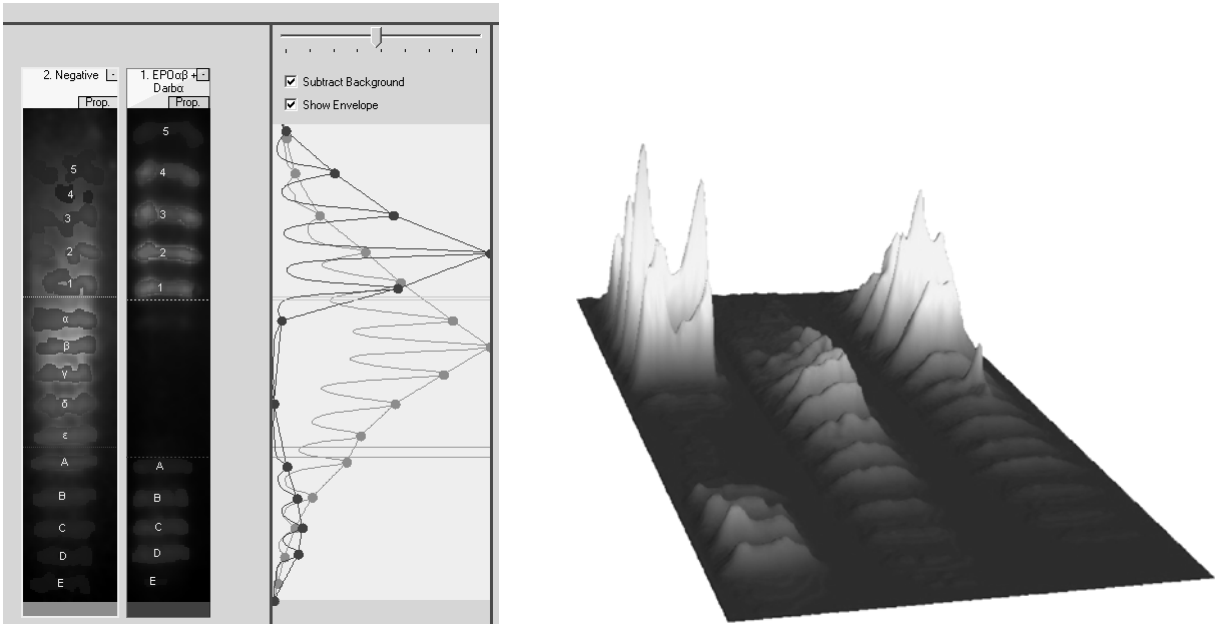

Figure 1. The new features in the GASepo V1.3.

Conclusion

The product of the project contributed directly to the aim of standardization and harmonization of the epo analytics. An effective epo-analytics expert network has been created. Scientific know-how in these areas has been extended and disseminated via a number of scientific publications. The GASepo software included several mathematical methods based on patented solutions. WADA-funded research in doping control has been promoted by a number of project-related presentations for broader public.

The high dissemination rate of the GASepo software prooves to the aim of standardization and harmonization.

Acknowledgements

This project was financially supported by the World Anti-Doping Agency (WADA).

The Most Important Publications

Bajla,I., Holländer,I., Minichmayr,M., Gmeiner,G., Reichel, C. (2005) GASepo – a software solution for quantitative analysis of digital images in EPO doping control. *Computer Methods and Programs in Biomedicine*. **80**, 246–270.

Reichel, C., Holländer,I., Gmeiner,G. (2006) Improvement in the background correction of Epo IEF images. In: *Proceedings of the 24rd Cologne Workshop on Dope Analysis,* Cologne, Germany.

Štolc,S., Bajla,I. (2006). Improvement of band segmentation in EPO images via column shift transformation with cost functions. *Medical and Biological Engineering and Computing* **44**, 257–274.