PD.TVZ.HR
POLYTECHNIC & DESIGN Vol. 11, No. 4, 2023.
Mrežna inačica: ISSN 2459-6302
Tiskana inačica: ISSN 1849-1995
DOI: 10.19279/TVZ.PD.2023-11-4-13

THE EXTENDED NIR NESTED IMAGE - ADDITIONAL SEPARATION VISUALIZED PROCEDURE

Ana Agić Cmrk[1], Vilko Žiljak[1,2], Darko Agić[2]

[1]Faculty of Graphic Arts, University of Zagreb, Getaldićeva 2, 10000 Zagreb
[2]HATZ Zagreb

ABSTRACT

From the graphic arts point of view, whose principles are often practiced in NIR technology, the secondary image is actually nested in the visual extent of the primary image. As the procedure basically does not enforces any hidden or special inks, materials or substrates, secondary image information is nested in spectral properties of basic colorants. As visual and NIR domains are separated, spectral differences argument for creating double images. NIR image is nested according to K ink achromatic interchange, and visualized in NIR domain by a separation process from the visual part.

Keywords: *inks spectral properties, NIR domain, separation resolving, visualization process*

1. INTRODUCTION

From the early days when IRD technology was made public [1], essential postulates were nominated to the audience and beneficiaries, such as where nothing is hidden, that in the system there are no invisible, secret or hidden layers or substrates, and only standard - usual inks were used. Some questions were immediately stated covering interchange module and principles of absorption/reflection inks properties in visual and near infrared domain. In initial research interchange engine was set similar to usual graphic arts reduction rate for black ink [2] [3], what very soon caused some problems, and absorption properties of carbon, carbon black ink, [4][5] considering to other chromatic basic printing inks [6], involving substrates and surrounding effects were considered. Contemporaneously with technical issues, usage, appliance, advantages, benefits and general meaning were discussed. Whilst optical properties of materials used, selection and instrumental visualization features in NIR domain were considered [7][8][9].

VIS-NIR environment is a huge sphere where all designers and explorers in technical, technological, art, medical, scientific, surveillance in various fields, exploring media, substrates chemical and physical properties can find their scope of interest. NIR surrounding as a "broadened reality" becomes just a term that can cover all that areas, what simply becomes common tool, resource and accustomed approach.

Figure 1 *Images sorted out: visual appearrance, file separations c-m-y and K presenting the NIR domain expanded image (demonstration, courtesy IRD team)*

Enforcement the system after introducing the technological principles, one of the first demonstration of extended NIR image was a portrait "hidden" in a chromatic green moderate intensity colored surface, and could be visualized instrumentally in NIR [10][11].

Fig. 1 presents basic surface, separations as they are bundled in the file, while "K separation" presents secondary image, that could be visualized instrumentally. Fig. 2 presents dialog box of the separation application showing channels.

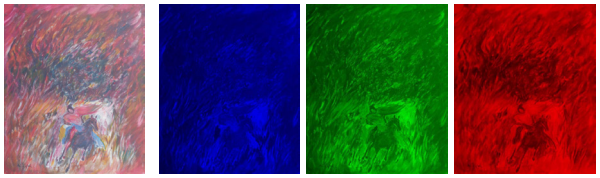
Figure 2 *Application channels dialog box*

In this example, of course, separation and visualization is carried out from the adequate prepared file, and displayed by the aid of application. It was one of the early IRD tech practical printed presentation.

2. ADVANCEMENT, PROPORTIONING, ALIGNMENT

As this part of visualization is carried out by the means of application, the separation or divarication has to be conducted at preparatory stage(s), so that the final account can be presented, and extended or secondary image information can be instrumentally visualized.

Human visual system covers the range of approximately 380 to 740 nm. Wavelength above 740 to 1200 nm are NIR domain. If we want to present some image, it according to rules of presenting has to be in a adequate lineament and corresponding profile, as for display purpose, is in RGB form. So some "multicolor original" is split in three parts:



a b

Figure 3 *"Multicolor" image (a), technical separations B G R (b) (demonstration), (Image courtesy Gallery Zelina)*

Technical procedure, separation, is performed with standard optical separation system, applicable at monitors, graphic arts and similar where a RGB to CMY conversion is needed. As we are dealing with standard media, inks and substrates, the secondary image information has to be nested (incorporated) within the visual part, with the information for extended area, NIR domain.

This nesting, or implementing information for extended domain image, in the primary image includes several presumptions, starting with basic differences of standard graphic reproduction c m y inks (chromatic colors) and black ink, carbon k. Chromatic inks (colors), as stated, due to their specific absorptions in visual express various colors. For major printing processes they are standardized (according to ISO/DIN), and in NIR domain their absorption is rather low. On other hand, carbon K renders high absorption along VIS and NIR domains. Fig.4: K spectral line:

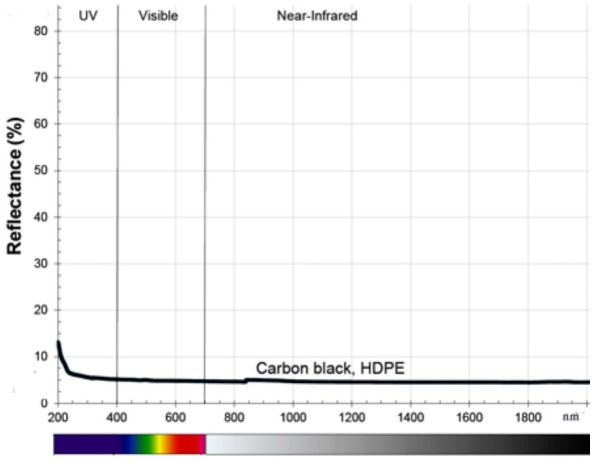


Figure 4 *Carbon black spectral line, VIS and NIR (example)*

According to standard graphic arts procedure,

achromatic change is applied to graphic reproduction to enhance it, make it more efficient, to reduce TAC, and for other practical and technical issues. This procedure involves and implies possibility to interchange (in a way substitute), certain achromatic and/or chromatic C-M-Y ink coverage combinations ("colors") with carbon K ink coverage in a appropriate way (amount).

3. ACHIEVING DOUBLE COLOR EXPERIENCE

A standard interchanging module used by image correction apps is partially embarrassing, while it is set to some high image coverage, and its setting as low-middle-high and a curve overview adjusting courses some practical issues. Particularly that model determines the interchange amount for each image position where possible. That method can cause some misalignment in extended image. A modified module is developed that interchanges K amount as unaltered yield.

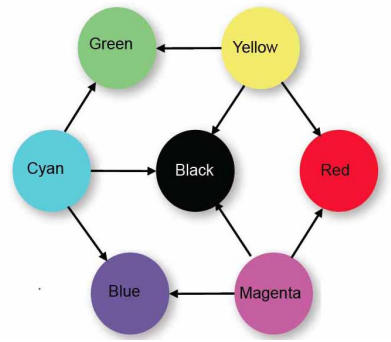


Figure 5 *Model of four color mixing*

Such combination of referred ink plus fixed amount is stable and assured for instrumental determination. Delta Z value is significant for NIR image determination.

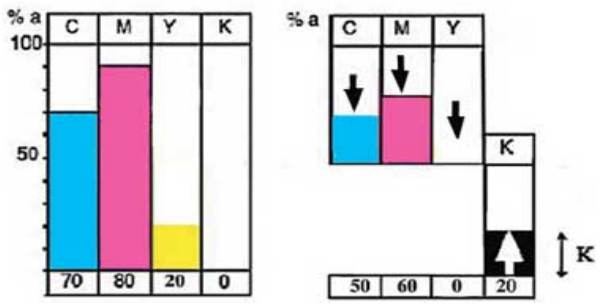


Figure 6 *Elemental interchange principle (max amount)*

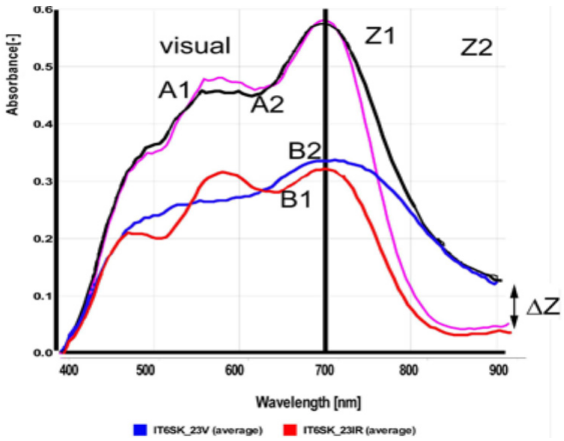


Figure 7 *Two ink combinations (twins), basic and interchanged with a stable black amount*

Such consideration often postulates considering about "twins". Practically each interchanged pair of color combination is a "twins" pair. They visually (in visual domain) render the same experience and could not be distinguished, if there is no some distortion.

4. DOMAINS SEPARATION, NIR VISUALIZATION

When interchanged information is nested in the primary "visual" image. Now the extended, additional separation occurs. NIR image visualization implicates situation that instrumentally is detected low intensity (high absorption) of carbon black from interchanged twin. This will perform a monochrome image on the NIR device visualization screen.

Standard sensitivity of a widely used camera sensor covers typically range from approximately 380 to 1200 nm and is set to capture a standard (visual) image.

Figure 8 *Visual filter, transparent only in visual domain*

Standard cameras have a build filter to exclude any wavelengths except visual. So first image captured, or at any other way prepared, is just imaged in approx. 400-700 nm range.

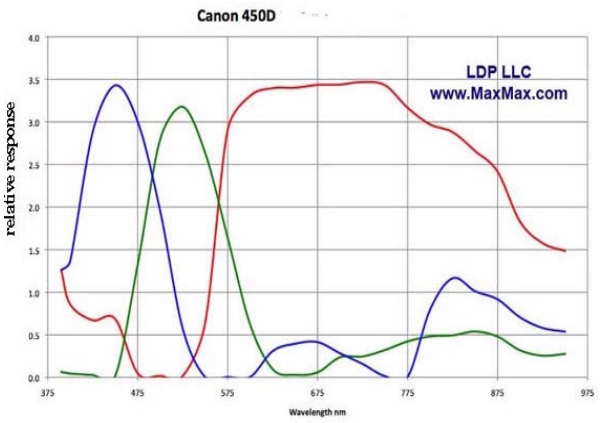


Figure 9 *Typical sensitivity of a camera sensor (Canon 4500)*

On the other hand, camera adjusted for NIR domain has to be disengaged from any influence from visual spectrum part. As presented in fig. 9, standard sensors are sensible over 700 nm, and this part is suitable for such as expanded secondary image, surveillance, art expressions, design, forgery, NIR domain for various purposes materials inspecting, medicine, and a wide range of other purposes.

The secondary image information is visualized in NIR domain, while the secondary camera is dedicated prepared for the target domain, fig 10.

So prepared both images are suitable to be visualized, and the secondary –extended NIR separation is prepared.

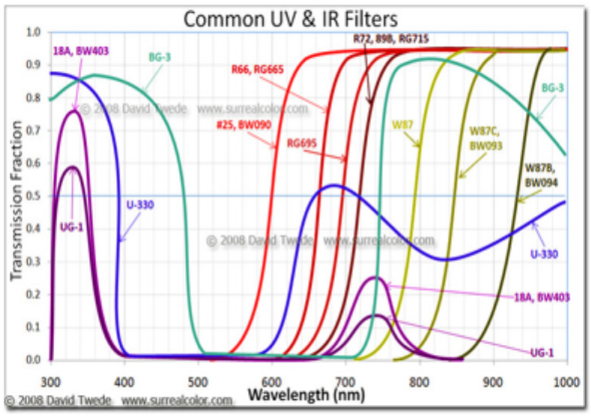


Figure 10 *Series of filters that can be used outside visual domain (UV, NIR)*

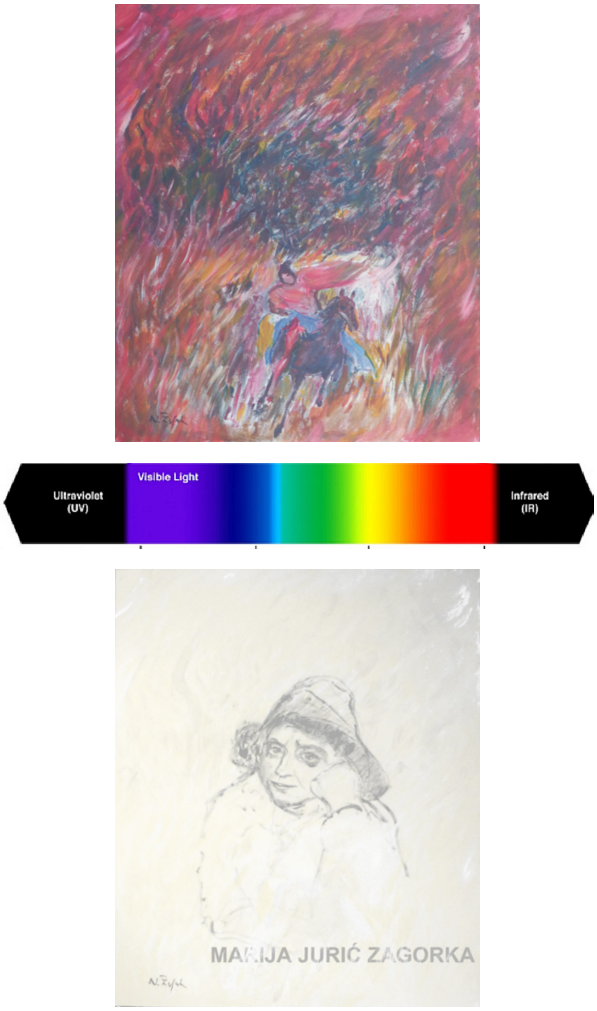


Figure 11 *Visual and NIR image according to spectral response (courtesy Zelina Gallery)*

5. BROADENING THE ENVIRONMENT

From the early investigations where idea of some simple visual broadening in the area outside the visual domain, NIR domain, utilizing inks spectral properties and splitting sensibility sensor domain as a extended separation was a very interesting project. Today, when dual and multispectral camera and measuring equipment is squarely available, possibilities are wide opened. Not only designers can broaden some additional information, treat them as “hidden” or specific, combining securities in documents and similar issues inks and substrates, technical, technological, art VIS/NIR improvements can be implemented in a various fields of activities and usages. Just ordinary investigations in various fields have constantly to be carried out.

6. REFERENCES

[1.] Žiljak I.; Projektiranje zaštitne grafike s promjenjivim bojama digitalnog tiska u vidljivom i nevidljivom dijelu spektra, Doktorska disertacija, Grafički fakultet Sveučilišta u Zagrebu, Zagreb, (2007).

[2.] Hunt. R. W. G, Kriss M. A; The Reproduction of Colour, John Wiley and Sons, ISBN 0-470-02425-9, Copyright © 2004 Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England

[3.] Enoksson E, Bjurstedt A; Compensation by black, Royal Institute of Technology (KTH) Stockholm, Sweden, 2006, Corpus ID: 67839031

[4.] Jäger C. Henning Th; Spectral properties of carbon black, J. of Non Crystaline Solids, vol 258 1-3 Nov. 1999, ht tps://doi.org/10.1016/S0022-3093(99)00436-6

[5.] Donnet, J.B; Carbon Black: Science and Technology, Science and Technology Second Edition, Revised and Expanded, Centre de Recherches sur la Physico-Chimie des Surfaces Solides, CNRS Mulhouse, France, CRC Press, print isbn 13: 9780824789756, 1993

[6.] Kurt N; The Physics and Chemistry of Color: ISBN: 978-0-471-39106-7 July 2001, Wiley, 2001

[7.] Savchenko K, Velychko O; Printing Inks Characteristics, Reprography Department, The Publishing and Printing Institute of the National Technical University, Journal of Materials Science and Engineering B 3 (7) (2013) 464-468

[8.] Pogarlčić I, Agić A, Matas M; Evaluation of the colorant twins for the neutral grey spectra in infrared graphic procedure 2016, Tehnički vjesnik, Vol. 23 No. 6, 2016.https://doi.org/10.17559/TV-2015030313203610.

[9.] Žiljak Stanimirović I, Žiljak Vujić J,; INFRAREDESIGN - New Design communication for Visual and Infrared spectrum, Corpus ID: 434130492013 IDA Congress Istanbul – Education and Research Conference 4

[10.] Žiljak V, Politis A, Agić A, Žiljak Vujić J, Agić D; Expanding Double Hidden Information with Infrared Dyes, Polytechnic and Design, Atena IC, 2014

[11.] Žiljak V, Pap K, I. Žiljak-Stanimirović, J. Žiljak-Vujić, (2012.); "Managing dual color properties with the Z-parameter in the visual and NIR spectrum", Infrared physics & technology, Elsevier B.V., Volume 55, Issue 4, July 2012, pp. 326-336, ISSN: 1350-4495. (CC, SCI, SCI-Expanded)