A Contribution for Information Security and Privacy - Cybernetic Camouflage Technology

JIŘI F. URBÁNEK & JIŘI BARTA
Department of Civil Protection
University of Defence
Kounicova 65, 662 10 Brno
CZECH REPUBLIC
jiri.urbanek@unob.cz

Abstract:This article is a co-product of Czech Defence Research Agency - acronym ADAPTIV. ADAPTIV project solution tends to Active Cyber-Camouflage by Computerized Aided Mimicry (CAM) implementing as autonomic outdoor computerized aided Workshop. Here usinguse cases of necessary systems and their technologies, they represent significant contribution for information security and privacy. Perceptive interface between a human recipient (observer) and visible object can be created by complicated components, domains, actors, agents and mediators. A permeability of this interface is necessary in an environment of collaborative actors at both sides of the interface. But, this interface worse or even none permeability can be asked between antagonistic enemies. Generally, a lot of various interfaces have "smash / fuzzy/ defocusing" contours but their exact definition is helpful for active and passive protection and security of living objects in the nature. But, the interfaces between potential enemies ask a merge of camouflage systems & processes, implementing on special created interface. So, this interface needs a nature / human made camouflage mediator. This mediator must operationally mediate virtual image in real time/ space/ environment. Cybernetic camouflage implementing virtual image operating in visible range of electromagnetic wave spectrum uses data projectors for projection of image on screen interface. From above fundamental principles are modelled platforms for cybernetic camouflage by means of method DYVELOP (Dynamic Vector Logistics of Processes),created on Czech University of Defence.Grant Project ADAPTIV deals new adaptive technology for simulation and camouflage in operational environment of armed forces of Czech Republic. The resources and "how to" of this Grant needs live power point presentation at Prague11th WSEAS International Conference on Information Security and Privacy (ISP '12).

Key-Words: Computerised Aided Mimicry Implementation, Cybernetic Active Camouflage, DYVELOP

1 Introduction

The Camouflage is concealment [1] by means of disguise. The likely root of the word camouflage is camoufler, a French term meaning smoke blown in someone's face as a practical joke. Word origin is in Italian camuffare. The Camouflage is a method of avoidance of observation that allows an otherwise visible object (organism or structure to remain indiscernible from the surrounding environment through deception). The theory of camouflage covers the various strategies which are used to achieve this effect. The definition of camouflage involves the both the concealment and the obscurity, whether applied to the natural coloration of animals, or used in military environment. The methods by which concealment or obscurity are attained share a common set of strategies intended to deceive the observer. The underlying methodology used in, whether natural or human-made. Camouflage is not limited to the commonly encountered visual way, but encompasses other senses as well. First, the camouflage must be tailored to the observer. Second, the camouflage must deceive the observer into making a false judgment about the camouflaged object.

Camouflage is an attempt to avoid observation, and as such, it is tailored to the vision of the expected observer. The use of camouflage, no matter what the specific application, has certain basic requirements that must be met. First, the camouflage must be tailored to the observer. Second, the camouflage must deceive the observer into making a false judgment about the camouflaged object. The strategies of camouflage can be broken down into up to four categories, which are cryptic, disruptive, counter-shading and mimicry. Each of these deals with a different method of deceiving the observer, and often strategies are combined

ISBN: 978-1-61804-127-2

increase their effectiveness. These may be applied individually, or in combination with one another providing overall camouflage strategy. The blending of disruptive and cryptic coloration can be called coincident disruption.

Cryptic (or blending) camouflage is an attempt to blend into the environment and become effectively imperceptible. To do this, the camouflaged object must minimize observable differences between itself and the background with respect to the senses of the target observer. The definitive example of camouflage is a cryptic camouflage designed to match the visual appearance of the expected background, generally using a mottled pattern of greens and browns to match ground and foliage colour and break up the outline of the camouflaged object. Cryptic camouflage must match the colours and spatial frequencies of the background to be effective, and may have to suppress non-visual cues.

Disruptive (or dazzle, US) camouflage is not intended to blend into the environment, and in fact often involves bright, eye-catching colours that would be the antithesis of cryptic camouflage. Disruptive camouflage seeks to confuse the observer, by providing visual cues that override the camouflaged object's features. This prevents the observer from accurately identifying characteristics of the camouflaged object(s), such as shape, size, orientation, and number of objects in a group combination of counter-shading and cryptic colours and patterns to blend into its environment.

Counter-shading is the process of using lighter colours on normally dark areas, and darker colours on normally light areas. This removes some of the visual cues used for depth perception causing the counter-shaded object to appear flat, rather than as an object with depth. This is the same effect used in the hollow-face illusion where a concave object is shaded in such a way as to appear convex. Military doctrine also applies this technique to camouflage paint. The standard method for applying camouflage paint to exposed skin is to use dark paint for bright areas of the face, light paint for shadowed areas, and combining this with a disruptive pattern over large areas of skin.

The Mimicry is the attempt by the camouflaged object to be observed as some other type of object. Mimicry is the similarity of one object to another which protects one or both. This similarity can be in the appearance, behaviour, sound, scent and even location, with the mimics found in similar places to their models. Mimicry occurs when a group of organisms, the mimics, evolve to share common perceived characteristics with another group, the models. The evolution is driven by the selective action of a signal-receiver, or dupe. For example, birds that use sight to identify palatable insects (the mimics), whilst avoiding the noxious models. Collectively, this situation is known as a mimicry complex[13]. The model is usually another species except in cases of auto-mimicry or specific mimicry occurs within a single species, one case being where one part of an organism's body resembles another part.. The signal-receiver is typically another intermediate organism like the common predator of two species, but may actually be the model itself, such as a moth resembling its spider predator. As an interaction, mimicry is in most cases advantageous to the mimic and harmful to the receiver, but may increase, reduce or have no effect on the fitness of the model depending on the situation. Models themselves are difficult to define in some cases, for example eye spots may not bear resemblance to any specific organism's eyes, and camouflage often cannot be attributed to a particular model. In some cases this can be quite a complex process, such as in the case of the Mimic Octopus, which is extremely flexible. Although all octopuses can change colour and texture, and many can blend with the sea floor, appearing as rocks, the Mimic Octopus is the first octopus species ever observed to impersonate other creatures – it can change shape to resemble lionfish or other poisonous fish in its habitat. Octopus ink cloud also provides disruption of the sense of smell e.g. Mimicry is perhaps the broadest example of adaptive camouflage (though the most obvious form to humans is visual mimicry).

Adaptive camouflage means a capability of an adapting object appearance to match its environment and/or impersonate other object. Adaptive camouflage (or active camouflage) is a group of camouflage technologies which would allow an object (usually military in nature) to blend into its surroundings by using of panels or coatings capable of changing colour or luminosity. Active camouflage can be seen as having the potential to become the perfection of the art of camouflaging things from visual detection.

2 Processes Modelling via DYVELOP

Perceptive processes between human Recipient (see PrS 1 in Table 1/ Fig.1) and visible Object of the camouflage are created by several complicated components, domains, actors, agents and mediators.

Very important agent of these processes, intermediating light physical processes perception, is an Observer (see PrS 2) always. The function of Observer´s Eye (see PrS 3) is relative heavy deceivable, while Observer with Brian = Observer in Recipient role is here the most inclinable to a mystification as regulative, control and evaluative Actor of camouflage process scene where he to Acquire an Illusion.

A disseminator of this Illusion is whole the Use Case: doing Camouflage Operational Scene, including all above relevant entities, operating into defined environment of visible camouflage: the visible ENV (see Table 1/ Fig.1).

Important Mediator of this Illusion is PrS 4: a Screen enabling front and back projection of Virtual Light Image (see PrS 6) and its perception as an Information (see PrS 7), perceptible by the Recipient. Generally, the Screen is the Interface enabling 2D/ 3D projection (cinerama, screen, monitor, foam, smoke ...). The Screen is crucial means for a deception of the Recipient (PrS 1).

In the domain of visible spectrum environment (visibleENV), the processes emerging by the use case „doing: CamouflageOperationalScene" are made by various number of infrastructural components, domains, actors, mediators and participants. But, from the point of view of deceitful or tricky camouflage processes – they are controlled by a Scenario in the role of operational function to do Scenario[15].

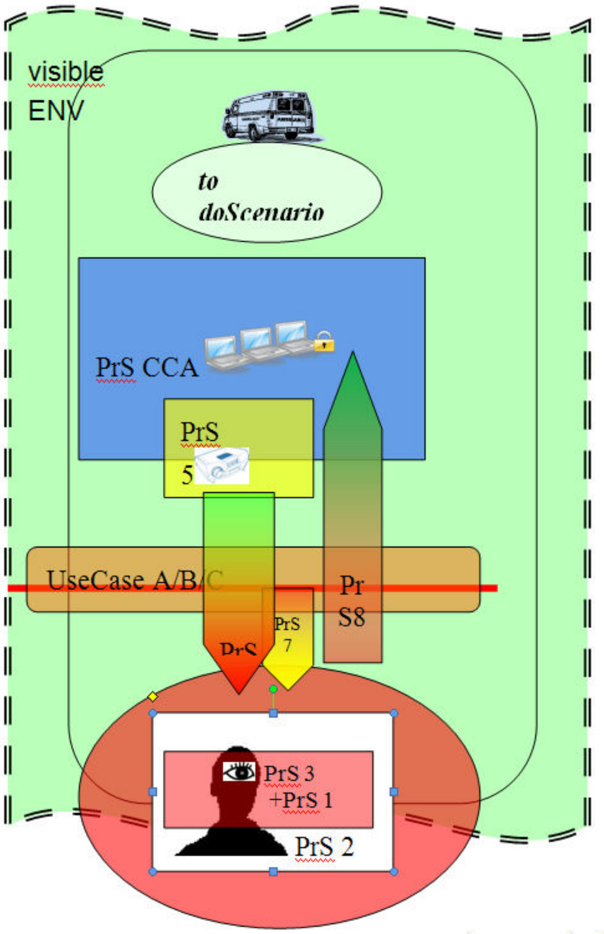

Fig. 1: Analysis

Entity´s		
title/symbol	**semantics**	**determination**
	Object of Camouflage	domain
visible ENV	Environment of Visible Camouflage	domain
PrS CCA	Cybernetic Computerized Aid Control System	3 notebooks in safe local net incl. Camouflage Plus Technology
PrS 1	Recipient	enemy actor process system
PrS 2	Observer	via brain
PrS 3	Observer´s Eye	human eye
PrS 4	Screen of front and back projection	canvas surface 2,2 x 2,2 m
PrS 5	Dataprojector	Panasonic
PrS 6	Virtual Light Image	light flow
PrS 7	Information	light perception
PrS 8	Information Feed Back & Reflection from PrS1	indicating behaviour
to doScenario	to Create Scenario of Camouflage	operational function=
to AcquireIllusion	to Percept Illusion	actor acquires the illusion
UseCase A	Visualization of Luminous Flow on 4 screens modular figuration type A	functional use case= for wide object covering
UseCase B	Visualization of luminous flow on 4 screens modular figuration type B	functional use case for square object covering
UseCase C	Visualization of luminous flow on 4 screens modular figuration type C	functional use case for high object covering
UseCase: doing CamouflageOperationalScene	Doing Function of Operational Scene Camouflage	camouflage scenery making
INTERFACE HW	Mediator of Human Recipient - Visual Illusion	surface of screens modular figuration

Table 1: Legend to Fig. 1

Cybernetic Camouflage needs the sensors of Information Feed Back & Reflection from enemy Recipient (PrS1) percepting visual illusion effect = to Acquire Illusion. It can be indicated just by a monitoring of PrS1´s behaviour in in the domains: visibleENV, real time & space. Cybernetic control system is represented by the PrS CCA: Cybernetic Computerized Aid.

3 ADAPTIV Project

The survival of human society requires the most effective behaviour aiming to the co-operation, collaboration, integration and technological ascendancy of friendly actors[12]. But security and defence research must offer pertinent means of protection for "native rival´s force" predominance counter antagonists and enemies. A camouflage systems and technologies is one from most important means for it.

ISBN: 978-1-61804-127-2

Cybernetic camouflage solves the Czech University of Defence R&D Grant of National Defence Research Project with acronym ADAPTIV - Draft and assertion new adaptive technology for simulation and camouflage in operational environment armed forces of Czech Republic and for infrastructure protection

ADAPTIV project solution has defined strict conditions which nominatives are a restriction of financial resources and exact definition of Project boundaries and conditions regarding researched and developed systems and technologies:

a/ Observer would be military person,

b/ Observer´s sense using for camouflage detection is limited to normal humans vision in visual range of luminous spectrum, without night vision systems, radar, sonar and thermal imaging as well,

c/ Omitting of other senses, such as olfaction (smell), touch, sound and hearing,

d/ Using cybernetic computerized aided technologies and dataprojectors for a visualisation acquired by COTS principle(Commercial Off The Shelf) [3],

e/ Omitting expensive and in the field untried technologies, as the lasers…

Human Eyes has specific characteristics: Normal human Eye see though the actions of four types of receptors in the eye; the rods, which are highly sensitive, perceive brightness, while three types of cones perceive red, green, and blue colours. The density and sensitivity of these rods and cones determine how sensitive the eye is to colour. Brightness is the most important factor, followed by green, red, and blue colours, in that order. Sometimes unexpected colours provide good cryptic coloration, such as pink. E.g. a shade called ´Mountbatten pink´ was used during WW II for ships. Human eye excites chromatic perception in the conditions of the visible radiation. Exact extent of visible radiation spectral range is impossible to set, because it is depending on incident radiation to eye retina and on spectral responsibility of observer eye. Lower boundary moves within the limits of wave longitude among 0,36 and 0,40 μm and upper boundary among 0,76 and 0,83 μm [4]. Radiation of light is visible radiation that is utilized by observer ocular organ. Every mono-frequency radiation excites quite definite coloured eye´s sensation, hence this radiation is indicating as monochromatic. In spectra solar radiation eye man can detect in circa 128 coloured tones.

4 Camouflage Best Practice in Military Environment

Military camouflage did not achieve widespread use until World War after the introduction of airplanes for an observation. This early camouflage was not restricted to just colouring, it applied to shape as well. United States Army Field Manual [5] in chapter 1(detailed information and how-tos): Camouflage uses concealment and deception to promote our offensive action, to surprise, to mislead the enemy, and to prevent him from inflicting damage upon us. It includes hiding from view, making hard to see clearly, arranging obstructions to vision, deceiving and disguising, and deception involving sound.

There are four fundamental ways of concealing installations activity and camouflage methods:

a. Blending. - An object is concealed by camouflage materials arranged so that both the materials and the object seem a part of their background. The aim is to prevent disclosure of the object by a change in the natural appearance of the site.

b. Hiding. - Hiding is concealing the identity of an object with a screen even though the screen itself may sometimes be seen.

c. Deceiving. - Deceiving simulates an object or activity of military significance or disguises them so they appear to be something else. Deceiving accomplishes the following:

d. Decoys. - Imitations of real objects are the basis for most deceptive practices. Although it is possible to make a decoy representation of any object, the most useful are decoy roads, , rocks, stumps, trees, hedges, guns, vehicles, planes, and buildings. Disguise changes the appearance of an object or activity to give a false impression of its character. The purpose may be either to create a military target or to conceal the object by making it appear to be of non-military significance.

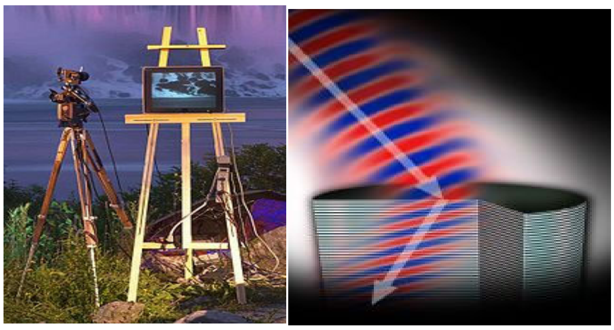

Fig. 2: Active camouflage “spring and future”

ISBN: 978-1-61804-127-2

5 Solution of ADAPTIV Project

In this paper, here it is necessary to highlight that problem solution is in CyberCamouflage INTERFACE HW (hardware), see red line at Fig. 2. This solution must be found between above two extremes regarding using hardware: between TV screens and “metamaterials” [2].

Czech University of Defence is solved of National Defence Research Project with acronym ADAPTIV - Draft and assertion new adaptive technology for simulation and camouflage in operational environment armed forces of Czech Republic and for infrastructure protection. This project´s aim: A using of the perspectives, research, development, implementation and application of cybernetic computerized aided technologies, intended for a protection of troop’s forces and equipments, of the civilians and technological infrastructure and for the simulation and camouflage of military activities and targets.

ADAPTIV Project R&D tends towards Active Camouflage by Computerised Aided Mimicry (CAM) implementations, using CAMouflagePlus Technology Scenarios: scene, scenery and object copies; rendering (intercepting) and /or emitting deceptive (illusory) virtual reality for relevant object change in the theatres of protective operations.

The (M.O.) Mimic Octopus[16] is “general pattern how-to“, of the ADAPTIV Project. CAM concept is here imagined as M.O. Its “eye” is CAM (Computerised Aided Mimicry) and its body is built by formalized DATABASE of the Pictures. The tentacles manifest capabilities of the Flexibility, Interoperability, Integration, Network Enabled Capability (NEC) and Computerized Aided Design (CAD). [14, 16]

6 Conclusion

Initiative milestones of Computerised aided camouflage of R&D Grant ADAPTIV were developed and implemented. They draft, content and use of new adaptive technologies for simulation and camouflage in operational environment for Czech Republic Armed Forces and for Czech infrastructure protection. The Active Cybernetic Camouflage by Computerised Aided Mimicry (CAM) implementations is followed from the project solution and “how to” and tends to field implementation. Already now, forming system serves especially for easy and well-arranged creation and displaying of visual information for digital adaptive camouflage protection of critical infrastructure and/or military forces, means & resources and/or for decoy´s simulation.

Acknowledgments

The article was elaborated within the defence research project with the acronymADAPTIV - Draft and assertion of new adaptive technology for simulation and camouflage in the operational environment of the armed forces of the Czech Republic and for infrastructure protection.(OVUOFEM 200,801).

References:

[1] Allen R. *The PENGUIN English Dictionary*, Penguin Books, 2003, ISBN 978-0-140-51533-6, p 197.

[2] http://en.wikipedia.org/wiki/

[3] Perry W. US State Secretary, *Military Doctrine*, 1994.

[4] Moulder, J.E. *Light*, 2004.

[5] *U.S. Army Field Manuals,* Army Publishing Directorate. 2007, FM 5-20.

[6] Sihvola, A., Vinogradov, A. P. *Metamaterials and Plasmonics: Fundamentals, Modelling, Applications*. New York: Springer-Verlag. 2008. ISBN9781402094064.

[7] Ziolkowski, E. N. *Metamaterials: physics and engineering explorations*. Wiley&Sons. 2006. ISBN 9780471761020.

[8] Shelby R. A., Smith D. R., Shultz S., Nemat-Nasser S.C. Microwave transmission through a two-dimensional, isotropic, left-handed metamaterial. *Applied Physic Letters 78*.2001.

[9] Urbánek J. F.Effective Modelling of Know-How for Cyber-Informatics Practitioners, In *8th Int. Conf. on Simulation, modelling and optimization, SMO '08,* Santander, Spain, WSEAS Press, 2008, pp. 252 - 255, ISBN 978-960-474-007-9, ISSN 1790-2769.

[10] Urbánek J. F. Application Modelling & Simulation of Data Flow in Disaster Events Management, In *8th Int. Conf. on Simulation, modelling and optimization, SMO '08,* Santander, Spain, WSEAS Press, Sept. 2008, ISBN 978-960-474-007-9, ISSN 1790-2769, pp 256-260.

[11] Urbánek J. F., Průcha J. A Development of Wireless Interoper-mobile Application for Outdoor Operation Management, In *8th Int. Conf. on Electronics, hardware, wireless and optical communications, EHAC ´09,,* Cambridge, UK, WSEAS Press, Feb. 2009,

ISBN 978-960-474-053-6, ISSN 1790-5117, ID 609-289, pp 57-64.

[12] Kyselák, J., Raclavská, J., Šuláková, L. Smart solution for area of population protection. In*Proceedings of the 10th WSEAS International Conference on Computational Intelligence, Man-Machine Systems and Cybernetics (CIMMACS´2011) and the 10th WSEAS International Conference Information Security and Privacy (ISP´11).* Jakarta, Island of Java, Indonesia: Published by WSEAS Press, 2011, p. 183-188. ISBN 978-1-61804-049-7.

[13] Ludík, T., Ráček, J. Process Methodology for Emergency Management. IFIP Advances in Information and Communication Technology, Heidelberg: Springer, 2011, 359, od s. 302-309, 8 s. ISSN 1868-4238. 2011. od s. 302-309.

[14] Urbánek J. F., Barta J., Heretik J., Průcha J. Computer Aided Camouflage, In *10th WSEAS Int. Conf. on Applied Informatics and Communications, AIC ´10,* Taipei, Taiwan, WSEAS Press, Aug. 2010, ISBN 978-960-474-216-5, ISSN 1792-460X, ID 609-289, pp 289-294.

[15] Urbánek, J. F. a kolektiv. *Scénářeadaptivníkamufláže (Scenarios of adaptive camouflage),* Brno: Tribun EU, 2012, 130 pp. ISBN: 978-80-263-0211-7.

[16] Urbánek J. F., Barta J., Heretik J., Navrátil J. and Průcha J. Cybernetic Camouflage, on Human Recipient – Visual Illusion Interface. Speaking In *The 9th WSEAS International Conference on COMPUTATIONAL INTELLIGENCE,MAN-MACHINE SYSTEMS and CYBERNETICS (CIMMACS '10),* University of Los Andes, Merida, Venezuela, December 14-16, 2010, ISBN 978-960-474-257-8, ISSN 1792-6998; Published In *WSEAS/Europment/EuroSAM International Conferences; December 29-31, 2010 Vouliagmeni, Athens, Greece; Recent Researches in Circuits, Systems, Electronics, Control & Signal Processing, Proceedings of the 9th WSEAS International Conference on CIRCUITS, SYSTEMS, ELECTRONICS, CONTROL & SIGNAL PROCESSING (CSECS'10);ISBN: 978-960-474-262-2, ISSN: 1792-7315, pp 22 – 27.*