I. J. Computer Network and Information Security, **2022, 1, 1-12**
Published Online February 2022 in MECS (http://www.mecs-press.org/)
DOI: 10.5815/ijcnis.2022.01.01

Specific Case of Two Dynamical Options in Application to the Security Issues: Theoretical Development

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Received: 13 August 2021; Revised: 16 October 2021; Accepted: 21 November 2021; Published: 08 February 2022

Abstract: In the presented paper it is investigated the influence of the subjective perception of the objectively existing security values upon the security measures and indicators in the framework of the subjective entropy maximum principle. The subjective analysis theory entropy paradigm makes it possible to consider the security system based upon dynamic parameters as an active system governed by an individual (active element of the managerial system) with the help of her/his individual subjective preferences optimal distributions obtained in conditions of the available situation multi-alternativeness and those achievable alternatives presence, as well as the active system active element's individual subjective preferences uncertainty. The described approach takes into account the simple two-alternative security situation in regards with the objectively existing effectiveness functions, related to security measures, in the view of a controlled parameter and a combination of it with its rate as the ratio. It is obtained the expressions for the objective functional extremal functions of the effectiveness and preferences, mathematically explicitly visualizing the security situation and allowing taking a good choice. The ideas of the required proper governing, managing, and control methods choice optimization with respect to only 2 alternative objective effectiveness functions arguments might be simple; nevertheless, increasing the number of parameters and further complication of the problem setting will not change the principle of the problem solution. This study is rather comparative. The significance and value of the study becomes clear in comparison with the theoretical results in the entropy paradigm field. Herein the solution obtained in the explicit view based upon the integral form objective functional. Such kind of dynamic optimization was not modeled in the background works.

Index Terms: Security, Object, Subject, Functional, Entropy, Uncertainty, Optimization, Preference function, Extremum.

1. Introduction

It is generally accepted that the security issues are the multifactor ones. The security in the aviation field of the transportation industry is not an exception.

The mentioned multifactor nature in security results in multi-alternativeness of situations. This leads to the uncertainty of the situations.

Entropy paradigm developed in [1-3] helps finding optimality in objectively existing processes. For the security problems formulations, it seems promising to apply the entropy paradigm adjusted to active systems [4,5].

In fact, the entropy approach following [1-5] developments made an evolution into the doctrine of the conditional optimality of the multi-optional effectiveness hybrid functions entropy [6-13]. In such context the proposed consideration proved to be valuable and could be prospective for applications similar to [14-25].

Therefore, major research objectives are to find the explanatory value extremized when considering information security object functioning, then determine the solutions to the optimization problem, after that reveal whether the suspected solutions really deliver either maximum or minimum to the objective value, and at last illustrate the main findings. Thus, the variational problem is to be solved in the article. Similar problem solutions unfound yet for the stated problem to that extend. The best solution is when it is checked at least with computer simulation, which is going to be carried out in result of this theoretical research. Such probation will clarify the limitations of the model. Hopefully, the maximum or minimum is attainable.

Specific security problem should be taken into consideration with regards to some objective effectiveness value and paying attention to that value rate, possibly a combination between those values.

2. Motivation behind this Work

The entropy procedures instigate evaluation and modeling in the sphere of security since it is subjectively stimulated areas of human perceptions, analogously to the active systems control [4,5]. It is very important to try to find some features of optimality in security degree assessments.

The reason of raising the motivation behind this work is theoretical developments for this introductory paper.

The following publication is going to prove the entropy maximum existence with the help of the variated solutions obtained herewith.

3. Contribution of Paper

Security object functional is proposed based upon the preferences entropy conditional optimality. Subjective individuals' evaluation of security is taken into account. Uncertainty of the security assessment is made through the entropy of the preferences functions.

Objective security effectiveness functions influence the available alternatives preferences functions. Risks, probabilities of some events, other parameters or values can be considered as those objective security effectiveness functions.

Dynamical security uncertainty estimation through entropy of the subjective individual preferences functions, thus, has been proposed and developed herewith the presented paper.

The use of the relative combined pseudo-entropy function for illustration of the security object "good" or "bad" ("correct" or "wrong") certainty / uncertainty in regards with the subjective individual preferences functions is also possible.

This study is rather comparative. The significance and value of the study becomes clear in comparison with the theoretical results in the entropy paradigm field. Herein the solution obtained in the explicit view based upon the integral form objective functional. It is considered as an information security functional comprising the preferences functions entropy as the measure of the subjective preferences uncertainty. Such kind of dynamic optimization was not modeled in the background works. Moreover, the specific case formulated with the ratio of the effectiveness function and its rate was not covered to that extent in the previous research yet.

4. Related Work

Jaynes, E. T. [1] proposed entropy approach to evaluate probability of state as optimal solution. The proposed functional in mathematical aspects is an object for conditional extremum solution. Such approach has been adopted in further research by the author as well as applied the presented paper.

Jaynes, E. T. [2] continues development of the entropy paradigm. It laid down foundations for the subjective entropy development and used here for a construction of the objective functional.

Jaynes, E. T. [3] states that evaluations with the help of entropy deal with the entropy maximum. This maximum has been found in the second part of the investigation.

Kasianov, V. [4] introduces subjective entropy of preferences. It is a cornerstone of subjective analysis. The entropy paradigm by Jaynes is used as a mathematical wrap for a new content. The idea is applied to the field of human-being activity in case when there is a possibility to choose between achievable (attainable) alternatives. It is postulated that such choice is realized in some optimal way. The subjective individuals' preferences functions are distributed on the set of the achievable (attainable) for the decision-making person in the way that the subjective entropy of the preferences functions undergo conditional maximum. The material delivered here is, in fact, one of the theory developments.

Kasjanov, V. & Szafran, K. [5] demonstrate some special hybrid models applications in the theory of active systems, which derived from the theory of subjective analysis. The similar analogy speculations are used for the theoretical creation.

Goncharenko, A. V. [6] proposed doctrine of the conditional optimality of the multi-optional effectiveness hybrid functions entropy to obtain objectively existing maximal probabilities of states in application to the problems about materials with the properties of damaging prior to failure.

Goncharenko, A. V. [7] demonstrates theoretical aspects of variational problem setting related to available alternatives of airworthiness analogies.

Goncharenko, A. V. [13] concentrates attention upon the possibilities of the variational problems with alternatives in the framework of the entropy paradigm. Those works generated the background for the presented paper idea of the dynamical alternative's effectiveness preferences entropy optimal assessment.

Dipti Yogesh Pawade [16] analyzes how a well-designed website using various search engine optimization (SEO) techniques can help to survive in the competition. Thus, for the students who are likely to be web developer in future; learning the theoretical concept of SEO is not enough. The way in which SEO strategy is being drafted varies as per the purpose of website. Hence along with the concept assimilation, instructor needs to make the student think critically to identify the problem and solve it in best possible way. Hence to explore the board panorama of SEO techniques, experiential and collaborative leaning techniques are used. The main objective of the study is to analyses the impact of these modern techniques on depth of concept assimilation by students. To ascertain the effect of these learning techniques, analytical data of the entire website is analyzed. Also, feedback is taken from student to know their perception about the whole process. It has been found that students enjoyed the whole learning process. The analytical data proves that the website performed really well which in turn proves that student got in depth understanding of the concept and they were able to implement it commendably in real world scenario. Therefore, there is a relevance to the presented herewith research in the objectives of a theoretical explanation of optimality in case of achievable alternatives.

Sameh. Azouzi, Jalel eddine. Hajlaoui, Zaki. Brahmi, and Sonia. Ayachi Ghannouchi [22] investigate that with the appearance of the COVID-19 pandemic, the practice of e-learning in the cloud makes it possible to: avoid the problem of overloading the institutions infrastructure resources, manage a large number of learners and improve collaboration and synchronous learning. In this paper, the authors propose a new e-leaning process management approach in cloud named CLP-in-Cloud (for Collaborative Learning Process in Cloud). CLP-in-Cloud is composed of two steps: i) design general, configurable and multi-tenant e-Learning Process as a Service (LPaaS) that meets different needs of institutions. ii) to fulfill the user needs, develop a functional and non-functional awareness LPaaS discovery module. For functional needs, the authors adopt the algorithm A* and for non-functional needs they adopt a linear programming algorithm. Their developed system allows learners to discover and search the learners' preferred configurable learning process in a multi-tenancy Cloud architecture. In order to help to discover interesting process, the authors come up with a recommendation module. Experimentations proved that their system is effective in reducing the execution time and in finding appropriate results for the user request. Hence, the mentioned multi-tenancy is an example of the multi-alternativeness studied here, thus it is proposed to take into consideration the dynamical uncertainty issues.

Mohammed Yousif, Ahmad Salim, and Wisam K. Jummar [18] deal with one of the most common problems in the design of robotic technology, which is the path planning. The challenge is choosing the robotics' path from source to destination with minimum cost. Meta-heuristic algorithms are popular tools used in a search process to get optimal solution. In this paper, their authors used Crow Swarm Optimization (CSO) to overcome the problem of choosing the optimal path without collision. The results of CSO compared with two meta-heuristic algorithms: PSO and ACO in addition to a hybrid method between these algorithms. The comparison process illustrates that the CSO better than PSO and ACO in path planning, but compared to hybrid method CSO was better whenever the smallest population. Consequently, the importance of research lies in finding a new method to use a new metahumanistic algorithm to solve the problem of robotic path planning. Thus, this fairly recent publication might be acknowledged as the one emphasizing the importance of the alternatives preferences functions entropy estimation in the problems of better (optimal) choice.

Béjar, S. M., et.al. [14,15] discussed the cutting speed and feed influence on surface microhardness of dry-turned UNS A97075-T6 alloy and fatigue behavior parametric analysis of dry machined UNS A97075 aluminum alloy. Amongst their investigations there is a potential of the entropy measures implementations (likewise proposed in this paper).

Hulek, D., and Novák, M. [17] analyzed the expediency of unmanned aircraft systems which happened to be an adjacent problem to the presented one since such analysis inevitably draws some subjective measures and uncertainty conditions.

Odarchenko, R. S., et.al. [19,20] paying attention to the improved method of routing in UAV network and estimation of the communication range and bandwidth of UAV communication systems obviously should have discussed some examples close to the formulated here.

Patel, G. C. M., et.al. [21] publication is one more pattern for the subjective entropy paradigm application, also likewise in the presented discussion, as it deals with the intelligent modelling of hard materials machining.

Solomentsev, O. and Zaliskyi, M. [23,24,25] demonstrated a wide variety investigational potential for the developed theoretical approach to the field of the efficiency of operational data processing for radio electronic equipment, data processing in case of radio equipment reliability parameters monitoring, and statistical data processing for condition-based maintenance. All this instigates entropy applicable research; and such pattern as this one can help formulate new problems and obtaining optimal solutions.

5. Specific Security Problem Consideration

A modification of the objective functional [4-11,16,17] is the integral expression of the following type.

The considered functional is $$\Phi_\pi = \int_{t_1}^{t_2} \left(-\sum_{i=1}^{N=2} \pi_i(t) \ln \pi_i(t) + \beta \left[\pi_1(t)\dot{x}(t) + \alpha \pi_2(t) \frac{\dot{x}(t)}{x(t)} \right] + \gamma \left[\sum_{i=1}^{N=2} \pi_i(t) - 1 \right] \right) dt, \quad (1)$$

where $[t_1, t_2]$ is the period of time t; $\pi_i(t)$ are the preferences functions related to the according available alternatives; β is the coefficient, which can be interpreted, depending upon the problem formulation, in terms of the weight coefficients, Lagrange uncertainty multipliers, cognitive parameters; $\dot{x}(t)=\frac{dx}{dt}$ is a security controlling function (the first derivative with respect to time) of the controlled parameter; α is a coefficient for equalizing the dimensions in the security object effectiveness function; $x(t)$ is the security controlled parameter (is the function of time herewith at the presented paper consideration as well, which makes the whole problem be a dynamical one); γ is one more corresponding structure parameter that can be considered at different problems settings as the Lagrange coefficient or weight coefficient, similarly to β.

However, in the presented formulation, the coefficient of β is used for the so-called subjective effectiveness function characterization [4].

The objective functional (1) contains a cognitive function [4].

$$\text{The cognitive function is } \pi_1(t)\dot{x}(t)+\alpha\pi_2(t)\frac{\dot{x}(t)}{x(t)}. \quad (2)$$

The entropy of the subjective security individuals' functions is presented in the model of the security conditional optimization objective functional (1) with the first under-integral member.

$$\text{The security preferences functions entropy is } -\sum_{i=1}^{N=2}\pi_i(t)\ln\pi_i(t). \quad (3)$$

Also, the integrand of the security functional (1) has a normalizing member.

$$\text{The security preferences functions normalizing condition is } \sum_{i=1}^{N=2}\pi_i(t)=1. \quad (4)$$

All three members of the expressions of (2)-(4) make the security functional (1) to model the optimal distributions for the security preferences functions as well as both securities controlled and controlling functions.

As to the integration of entropy (4) over the time interval of $[t_1, t_2]$, such integral definitely somehow relates with the average security preferences functions uncertainty measured for the same $[t_1, t_2]$ time period [4].

The optimization problem formulated as stated above (1)-(4), in fact, is a specific case of the more general problem considering the case when an active security object is under control of the system of the available alternatives preferences.

An active security system operation or functioning is schematically described with the illustration shown in Fig. 1.

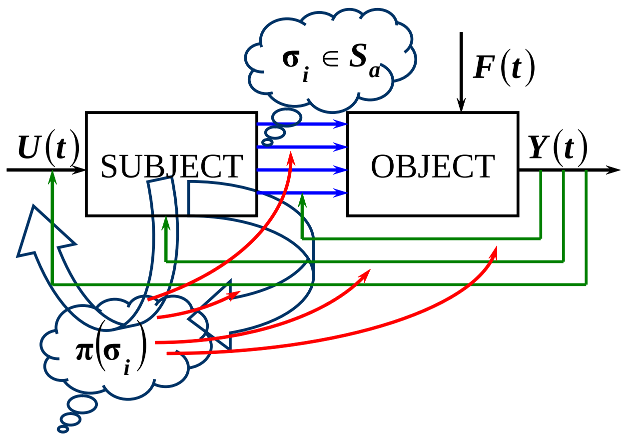

Fig.1. Presence of a Subject in the system of a communicational networks control

The interpretations of the illustration presented Fig. 1 can be as follows.

The presence of a subject (see Fig. 1) in the security control system makes the dynamic security control function, depicted as $U(t)$, generated by the external "governor" (not shown in the scheme in Fig. 1 for the conceptual perceptional easiness), and influencing the object, be multi-alternatively modified in accordance with the subject's individual preferences $\pi(\sigma_i)$ somehow optimally distributed upon the set of S_a of the considered by the individual at the moment of time t achievable alternatives σ_i.

The external dynamic influence exerted upon the object is denoted as $F(t)$. The output parameter of the security-controlled system is represented with the function of time $Y(t)$ (see Fig. 1).

Here it should be emphasized that the difference of the proposed consideration symbolized in Fig. 1 from the traditional control system theory is that the subject's individual preferences $\pi(\sigma_i)$ sometimes drastically change the dynamically controlling function of $U(t)$ and it is not always and necessarily in the correct, proper form. The list of examples might be endless; one can mention just a few cases related to security and safety issues with the notorious human factor in civil aviation when operating aircraft. The identification of the security hazard can be wrong, or the security risk might be under or over estimated. The autopilot hardly ever fails and wrongly changes the flight configuration of the aircraft at normal flight conditions and situations. But because of the sensor's failures or onboard instruments wrong showings the human-pilot gets nervous, due to communication with the co-pilot it might raise panic with the inevitable dramatically conclusion. The engine fuel governor will probably not go wrong just because of the fire signaling lamp starts flashing for some malfunctioning happened to the circuit and not the real fire. But the operator might, mistakenly identifying the trouble and being under the stress of the situation (as well as communication network), distribute his/her preferences in such way that it might lead to the unneeded fire extinguishing system activation with the engine stop in flight and sad effect.

The distribution of the described such security aimed preferences is supposed to be optimal; moreover, the uncertainty of the preferences distribution should be taken into account.

For that purpose, one could use the postulated functional of the general view that has been used for construction (1) and that follows the references [4].

$$\text{The general view functional is } \Phi_\pi = \alpha H_\pi + \beta\varepsilon + \gamma\mathscr{N}, \tag{5}$$

where α, β, γ are the corresponding structure parameters that can be considered, as above, at different problems settings as the Lagrange coefficients or weight coefficients. Here they are interpreted as internal security object control parameters which reflect certain properties of the security object "attitude" to the achievable alternatives. H_π is the entropy of the alternatives preferences π; ε is the function of the effectiveness that together with the alternatives preferences entropy H_π determines conditions of the attainable alternative preferences π distribution optimality; $\mathscr{N}$ is normalizing condition.

The general problem is to find the available (security) alternatives preferences π optimal distribution on the conditions formulated as the objective functional (5). Here, it is for the specific case (1)-(4).

One intermediate problem setting between the general case functional (5), and problem statement described herewith as of the expressions (1)-(4) is next.

Here is a consideration of the objective functional of the view of (5), in regard to the expressions of (2)-(4). It has the integral form.

$$\text{The general view integral form functional is } \Phi_\pi = \int_{t_1}^{t_2} \left(-\sum_{i=1}^{N} \pi_i(t) \ln \pi_i(t) + \beta \sum_{i=1}^{N} \pi_i(t) F_i + \gamma \left[\sum_{i=1}^{N} \pi_i(t) - 1 \right] \right) dt, \tag{6}$$

where i – number-index of the corresponding attainable alternative; N – the total number of the alternatives; F_i is the security-object effectiveness function of the i-th achievable alternative.

Thus, the second member of (6), analogously to the integral of the entropy taken in the view of (3) relates with some mean magnitude of the function ε (see equation (5)) value for the period of integration $[t_1, \ldots, t_2]$.

The solution of the security objective functional (1) with the under-integral function (integrand) of the (2)-(4) expressions have to be obtained at the extremals.

$$\text{The extremals are } \pi_1^0(t), \quad \pi_2^0(t), \quad \text{and} \quad x_0(t). \tag{7}$$

In order to get the solution to the specific case of (1) as of (7) a certain designation is proposed.

The designation of the integrand is $R^* = -\sum_{i=1}^{N=2} \pi_i(t) \ln \pi_i(t) + \beta \left[\pi_1(t) \dot{x}(t) + \alpha \pi_2(t) \frac{\dot{x}(t)}{x(t)} \right] + \gamma \left[\sum_{i=1}^{N=2} \pi_i(t) - 1 \right].$ (8)

The extremals of (7) are to be obtained, in turn, from the objective functional (1), with (8), necessary extremum existence conditions notated in the view of the Euler-Lagrange equations.

The Euler-Lagrange equations are $\frac{\partial R^*}{\partial \pi_i} - \frac{d}{dt} \frac{\partial R^*}{\partial \dot{\pi}_i} = 0$ and $\frac{\partial R^*}{\partial x} - \frac{d}{dt} \frac{\partial R^*}{\partial \dot{x}} = 0$. (9)

In the given considered case (1), the under-integral function (8) does not depend upon the rate of the preferences change in time.

The first derivatives of the preferences with respect to time are $\dot{\pi}_i = \frac{d\pi_i}{dt}$. (10)

Because of such independence the second member of the first equation of (9) will equal 0.

The simplifications for the first equation of (9) are $\frac{\partial R^*}{\partial \dot{\pi}_i} \equiv 0$ and $\frac{d}{dt} \frac{\partial R^*}{\partial \dot{\pi}_i} \equiv 0$. (11)

Hence, the system of equations (9) gets the simplified view.

The simplified view of system (9) is $\frac{\partial R^*}{\partial \pi_i} = 0$ and $\frac{\partial R^*}{\partial x} - \frac{d}{dt} \frac{\partial R^*}{\partial \dot{x}} = 0$. (12)

Accordingly, conditions (12) yield for preferences next partial derivatives.

The partial derivative with respect to preference π_1 is $\frac{\partial R^*}{\partial \pi_1} = -\ln \pi_1 - 1 + \beta \dot{x} + \gamma = 0$. (13)

And with respect to preference π_2 it is $\frac{\partial R^*}{\partial \pi_2} = -\ln \pi_2 - 1 + \alpha\beta \frac{\dot{x}}{x} + \gamma = 0$. (14)

From equations (13) and (14) it is possible to obtain the expressions in the explicit view.

The preferences functions are $\pi_1 = e^{-1+\beta\dot{x}+\gamma} = e^{\gamma-1} e^{\beta\dot{x}}$ and $\pi_2 = e^{-1+\alpha\beta\frac{\dot{x}}{x}+\gamma} = e^{\gamma-1} e^{\alpha\beta\frac{\dot{x}}{x}}$. (15)

Conditions of normalizing bring the normalizing member.

The sum of the preferences functions is $\pi_1 + \pi_2 = 1 = e^{\gamma-1} e^{\beta\dot{x}} + e^{\gamma-1} e^{\alpha\beta\frac{\dot{x}}{x}} = e^{\gamma-1} \left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}} \right)$. (16)

The normalizing member is $e^{\gamma-1} = \frac{1}{e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}}$. (17)

For the preferences functions, after (15)-(17), it gives canonical expressions [16].

The preferences functions are $\pi_1 = \frac{e^{\beta\dot{x}}}{e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}}$ and $\pi_2 = \frac{e^{\alpha\beta\frac{\dot{x}}{x}}}{e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}}$. (18)

The extremal solution for $x(t)$ is also being found from conditions of (9) or (12).

The partial derivative with respect to $x(t)$ is $\frac{\partial R^*}{\partial x} = -\frac{\alpha\beta\pi_2\dot{x}}{x^2}$. (19)

For the second member of the Euler-Lagrange equation it must be derived its own expression.

The partial derivative with respect to $\dot{x}(t)$ is $\frac{\partial R^*}{\partial \dot{x}} = \beta\pi_1 + \frac{\alpha\beta\pi_2}{x}$. (20)

After that the second member of the Euler-Lagrange equation can be obtained.

The complete derivative of (20) with respect to t is $\frac{d}{dt}\frac{\partial R^*}{\partial \dot{x}} = \beta\dot{\pi}_1 + \alpha\beta\left(\frac{\dot{\pi}_2 x - \pi_2\dot{x}}{x^2}\right)$. (21)

The Euler-Lagrange equation then can be written as following.

The Euler-Lagrange equation for $x(t)$ is $-\frac{\alpha\beta\pi_2\dot{x}}{x^2} - \beta\dot{\pi}_1 - \left[\alpha\beta\left(\frac{\dot{\pi}_2 x - \pi_2\dot{x}}{x^2}\right)\right] = 0$. (22)

Which means $-\beta\dot{\pi}_1 - \left[\alpha\beta\left(\frac{\dot{\pi}_2}{x}\right)\right] = 0$. (23)

Thus, the procedure of (19)-(23) leads to the relation between the rates of preferences.

The dependence for the rates of preferences is $\dot{\pi}_1 = -\alpha\left(\frac{\dot{\pi}_2}{x}\right)$. (24)

Having the expression (24) there is a need of having the equations for the rates of preferences.

In the given problem setting $\frac{\partial \pi_1}{\partial x} = -\frac{e^{\beta\dot{x}}\left(-\alpha\beta\frac{\dot{x}}{x^2}e^{\alpha\beta\frac{\dot{x}}{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2} = \alpha\beta\frac{\dot{x}}{x^2}\pi_1\pi_2$. (25)

With respect to $\dot{x}(t)$ it will be one more equation.

The partial derivative is $\frac{\partial \pi_1}{\partial \dot{x}} = \frac{\beta e^{\beta\dot{x}}\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right) - e^{\beta\dot{x}}\left(\beta e^{\beta\dot{x}} + \frac{\alpha\beta}{x}e^{\alpha\beta\frac{\dot{x}}{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}$. (26)

The equation of (26) can be transformed.

The transformed equation is $\frac{\partial \pi_1}{\partial \dot{x}} = \frac{\beta e^{\beta\dot{x}}\left(e^{\alpha\beta\frac{\dot{x}}{x}}\right) - e^{\beta\dot{x}}\left(\frac{\alpha\beta}{x}e^{\alpha\beta\frac{\dot{x}}{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}$. (27)

And the equation of (27) can be simplified in turn.

The simplified equation is $\frac{\partial \pi_1}{\partial \dot{x}} = \beta \pi_1 \pi_2 \left(1 - \frac{\alpha}{x}\right)$. (28)

Therefore, the complete derivative of the first preference rate will acquire a corresponding view.

The complete derivative is $\dot{\pi}_1 = \frac{d\pi_1}{dt} = \frac{\partial \pi_1}{\partial x}\dot{x} + \frac{\partial \pi_1}{\partial \dot{x}}\ddot{x}$. (29)

Substituting (25)-(28) for (29) there is a possibility to represent it as next.

The complete derivative is $\dot{\pi}_1 = \alpha\beta\left(\frac{\dot{x}}{x}\right)^2 \pi_1\pi_2 + \beta\pi_1\pi_2\left(1 - \frac{\alpha}{x}\right)\ddot{x}$. (30)

Next up is the step for the complete derivative of the second preference rate. First, consider the partial derivative with respect to the controlled security parameter.

The partial derivative is $$\frac{\partial \pi_2}{\partial x} = \frac{-\alpha\beta\frac{\dot{x}}{x^2}e^{\alpha\beta\frac{\dot{x}}{x}}\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right) - e^{\alpha\beta\frac{\dot{x}}{x}}\left(-\alpha\beta\frac{\dot{x}}{x^2}e^{\alpha\beta\frac{\dot{x}}{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}.$$ (31)

The expression of (31) can also be transformed.

The transformation is $$\frac{\partial \pi_2}{\partial x} = \frac{-\alpha\beta\frac{\dot{x}}{x^2}e^{\alpha\beta\frac{\dot{x}}{x}}\left(e^{\beta\dot{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}.$$ (32)

Also, there can be a simplification of (32).

The simplification yields $\frac{\partial \pi_2}{\partial x} = -\alpha\beta\frac{\dot{x}}{x^2}\pi_1\pi_2$. (33)

On the other hand, there is a necessity for the partial derivative with respect to the rate.

The partial derivative is $$\frac{\partial \pi_2}{\partial \dot{x}} = \frac{\frac{\alpha\beta}{x}e^{\alpha\beta\frac{\dot{x}}{x}}\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right) - e^{\alpha\beta\frac{\dot{x}}{x}}\left(\beta e^{\beta\dot{x}} + \frac{\alpha\beta}{x}e^{\alpha\beta\frac{\dot{x}}{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}.$$ (34)

Now, the transformation and simplification in the manner of (26)-(28) can be applied to (34).

The transformation is $$\frac{\partial \pi_2}{\partial \dot{x}} = \frac{\frac{\alpha\beta}{x}e^{\alpha\beta\frac{\dot{x}}{x}}\left(e^{\beta\dot{x}}\right) - e^{\alpha\beta\frac{\dot{x}}{x}}\left(\beta e^{\beta\dot{x}}\right)}{\left(e^{\beta\dot{x}} + e^{\alpha\beta\frac{\dot{x}}{x}}\right)^2}.$$ (35)

Equation (35) needs the simplification.

The simplification is $\frac{\partial \pi_2}{\partial \dot{x}} = \beta \pi_1 \pi_2 \left(\frac{\alpha}{x} - 1 \right)$. (36)

Hence, the complete derivative of the second preference rate will acquire its corresponding view too.

The complete derivative is $\dot{\pi}_2 = \frac{d\pi_2}{dt} = \frac{\partial \pi_2}{\partial x} \dot{x} + \frac{\partial \pi_2}{\partial \dot{x}} \ddot{x}$. (37)

Substitutions for (37) give the wanted result.

The complete derivative is $\dot{\pi}_2 = -\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 \pi_1 \pi_2 + \beta \pi_1 \pi_2 \left(\frac{\alpha}{x} - 1 \right) \ddot{x}$. (38)

Corresponding substitutions for (24) will yield the sought equation.

The second order equation is $\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 \pi_1 \pi_2 + \beta \pi_1 \pi_2 \left(1 - \frac{\alpha}{x} \right) \ddot{x} = -\frac{\alpha}{x} \left[-\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 \pi_1 \pi_2 + \beta \pi_1 \pi_2 \left(\frac{\alpha}{x} - 1 \right) \ddot{x} \right]$. (39)

Equation (39) can be transformed by canceling $\pi_1 \pi_2 \neq 0$.

The transformation is $\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 + \beta \left(1 - \frac{\alpha}{x} \right) \ddot{x} = -\frac{\alpha}{x} \left[-\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 + \beta \left(\frac{\alpha}{x} - 1 \right) \ddot{x} \right]$. (40)

One solution of (40) is when the member in the brackets does not equal 0.

The condition is $\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 + \beta \left(1 - \frac{\alpha}{x} \right) \ddot{x} \neq 0$. (41)

The condition (41) means the simple result.

It is $\frac{\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 + \beta \left(1 - \frac{\alpha}{x} \right) \ddot{x}}{\alpha\beta \left(\frac{\dot{x}}{x} \right)^2 + \beta \left(1 - \frac{\alpha}{x} \right) \ddot{x}} = \frac{\alpha}{x} = 1$. (42)

From (42) it gives the optimal solution.

The optimal solution is $x = \alpha$. (43)

The same as the (43) result directly follows (24).

If $\dot{\pi}_2 \neq 0$. (44)

The normalizing condition implies (4).

The first alternative preference function will be $\pi_1 = 1 - \pi_2$. (45)

From (45) it can be obtained the expressions for the derivatives.

The derivative is $\dot{\pi}_1 = \frac{d(1 - \pi_2)}{dt} = -\frac{d\pi_2}{dt} = -\dot{\pi}_2$. (46)

Substituting (46) for (24) leads to (43).

$$\text{The relation is } -\dot{\pi}_2 = -\frac{\alpha}{x}\dot{\pi}_2 . \tag{47}$$

The equation (47) clearly shows the simplest result (43). This, in turn, highlights the specific case study with the maximum-security options preferences entropy result.

$$\text{The entropy extremum preferences distribution is } \pi_1 = \pi_2 = \frac{1}{2} . \tag{48}$$

The other solution of (40) is when the member in the brackets does equal 0.

$$\text{The condition is } \alpha\beta\left(\frac{\dot{x}}{x}\right)^2 + \beta\left(1-\frac{\alpha}{x}\right)\ddot{x} = 0 . \tag{49}$$

The second order equation will correspond (40) and (49) at $\beta \neq 0$.

$$\text{The equation is } \ddot{x} = \frac{\alpha\left(\frac{\dot{x}}{x}\right)^2}{\left(\frac{\alpha}{x}-1\right)} . \tag{50}$$

From equation (50) it is visible that solution of (43) differs from the one obtained from (50).

6. Result Analysis

As a result of the theoretical contemplations described with the help of the formulas derived and presented with the relations and expressions of (1)-(50), there are a few moments worth noticing.

There are two optimal solutions to the objective functional (1). Such functional is a convenient modification for solving dynamical problems of some security issues dealing with the security-controlled parameter $x(t)$ and security controlling function $\dot{x}(t) = \frac{dx}{dt}$ specifically combined into subjective effectiveness and cognitive function (2).

The modification of functional (1) is also in the integral form of the conditional optimization of subjective security preferences functions entropy (3), which takes into account a relative indirect assessment of the function's uncertainty degree over the specified period of integration. Also, the functional (1) modification is a special case of the general form objective functionals (5) and (6).

The suspected for the optimum of the objective functional (1) solutions, namely those two given with the formulas of (43) and (50), are found based upon the postulated [4] variational principle of subjective entropy conditional optimality following the Jaynes' entropy maximum principle [1-3]. The subjective entropy maximum principle implies the essential influence of the individual's system of preferences upon the decision-making process. And herein it is interpreted for the security evaluation issues.

The solutions of (43) and (50) compliment one another.

However, it must be checked or proved somehow the extremality of the (43) and (50) solutions.

The research following this one is going to be dedicated specifically to such modeling and simulation. There it is expected to be revealed the presence of either maximum or minimum of the value.

7. Conclusion and Future Scope

On the basis of the found results, there can be drawn some conclusion. The impact of the achievable alternatives subjective individual effectiveness preferences functions uncertainty is quite possible in terms of the entropy paradigm at the subjective estimation of security. The entropy conditional optimization approach allows obtaining extremals as solutions of the specific variational problems for the objective functional in the explicit view of the preferences functions as well as sought variated function.

Thus, the state of knowledge in the field has been advanced by the work from the present state to new theoretical results in the simplified specific case when the subjective effectiveness function includes parameters of a controlled function and the members evaluating the ratio of the controlled function rate to the controlled function value. The found dependences are the elements of a scientific justification of the theory development.

Nevertheless, the extremals must be tried on the purpose of revealing their true maximum or minimum existence at least by varying the resulted functions and studying those variations in future research.

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How to cite this paper: Andriy V. Goncharenko, "Specific Case of Two Dynamical Options in Application to the Security Issues: Theoretical Development", International Journal of Computer Network and Information Security(IJCNIS), Vol.14, No.1, pp.1-12, 2022. DOI: 10.5815/ijcnis.2022.01.01