CONTROL OF THE LIGHTING SYSTEM USING A GENETIC ALGORITHM

by

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The manufacturing, distribution and use of electricity are of fundamental importance for the social life and they have the biggest influence on the environment associated with any human activity. The energy needed for building lighting makes up 20-40% of the total consumption. This paper displays the development of the mathematical model and genetic algorithm for the control of dimmable lighting on problems of regulating the level of internal lighting and increase of energetic efficiency using daylight. A series of experiments using the optimization algorithm on the the realized model confirmed very high savings in electricity consumption.

Key words: *lighting control, genetic algorithm, HVAC*

Introduction

Today, the world is facing two big energy problems. The first is the energy demand which is growing faster than the current manufacturing capacities based mostly on unrenewable energy sources [1] and the second is environmental polution and climate changes caused by excessive and irrational consumption. The share of business-residential objects in total energy consumption is 40% and in CO_2 emission is 36% [2, 3].

People spend more than 80% of their daily time in closed spaces for which it is necessary to be adapted to their current activity or mood. The most important element in the space is light, primarily because of the psychological effect that the high quality lighting of space has on the persons which live and work in the space. Numerous researches conclude that the natural lighting has a positive effect on the eyesight, visual comfort, psychological effect, health, and work productivity [4-6].

Increasing the quality of the environment in the right way means creating a well sofisticated system of dynamic lighting which enables the lighting without glare, adjustable by intesity and accurately terminated. In the natural environment the sun is the source of the dynamic and biological lighting which has a direct impact on the biological functions of the organism.

The energy needed for the lighting within the buildings comprises 20-40% of all the consumption and is one of the main contributors of CO_2 emissions [7-9]. Because of that the

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new criteria of energy efficiency has been set [10, 11] due to the importance of lighting in the reduction of total energy consumption [12]. Precisely, recent studies indicate that the use of daylight as a renewable source of energy can make significant savings in the range of 30-77% [13-16], by integrating into the presence detector system, dimming, *etc.* next to the controllers and sensors. In addition to space heating, the consumption of the cooling system can be reduced as well as the general requirements for the HVAC systems operation (heating, ventilating and air-conditioning) [17, 18].

Mathematical representation of the lighting components used in the paper

In order to understand the dynamics and project the control for a complex system, it's mathematical model must be well understood. In practice, the systems under consideration can be very complicated or their nature is not fully known, so during the process of modeling it is necessary to introduce (adopt) some conditions, neglects and simplifications.

The point method is intended for calculation of the brightness at any point of the observed plane. The brightness of a point P in the plane consists of: direct and indirect (difusal) component.

The direct component in the point occurs from the lights operation, and the indirect component from the operation of the light reflected from surfaces in the room. To calculate the direct component it's necessary to know the distribution diagram of the lamp's light intensity. The direct light component consists of two components: horizontal and vertical lighting.

In order to calculate the indirect lighting component certain factors must be well known like reflection, room area, as well as the overall luminous flux of all sources in the room.

Direct lighting component

The lamp is considered to be the point source if its distance from the illuminated point is at least five times greater than its maximum extent.

The horizontal component of the direct lighting component (fig. 1) is calculated according to the formula:

$$E_h = \frac{I_y}{h_\mathrm{p}^2} \cos^3\gamma \tag{1}$$

where I_γ is the luminous intensity of lights at the angle γ [cd] and h_p is the vertical distance between the lamp and the point where the calculation is conducted.

The total horizontal direct lighting component in the observed point is obtained by operation of n lamps and is calculated using the equation:

$$\Sigma E_h = E_{h1} + E_{h2} + \ldots + E_{hn} \tag{2}$$

The direct component of the vertical lighting (fig. 2) in the observed point is obtained by operation of a single lamp and is calculated according to the equation:

$$E_v = \frac{I_y}{h_\mathrm{p}^2} \cos^2\gamma \sin\gamma \tag{3}$$

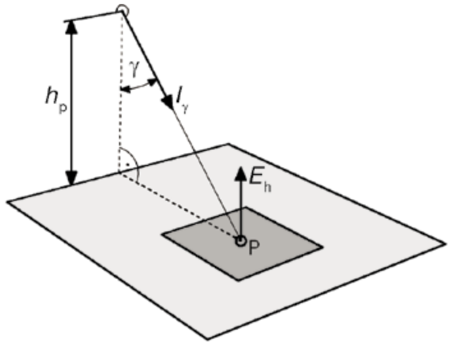

Figure 1. Illustration of the calculation of the value of the horizontal component of the direct lighting component at the point source of light

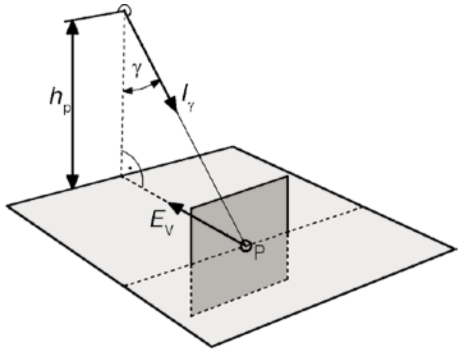

Figure 2. Illustration of the calculation of the value of the vertical component of the direct lighting component at the point source of light

The total horizontal direct lighting component in the observed point, is obtained by operation of n lamps and is calculated using the equation:

$$\Sigma E_v = E_{v1} + E_{v2} + ... + E_{vn} \tag{4}$$

Indirect lighting component

The share of indirect (reflected) lighting component is calculated under the assumption that the reflected light is evenly distributed across the plane on which the P point is lying. The calculation is executed according to:

$$E_{\text{ind}} = \frac{\Phi_{\text{cel}} \rho_{\text{sr}}}{\sum A_n (1 - \rho_{\text{sr}})} \tag{5}$$

where Φ_{cel} is the overall luminous flux of all light sources in the room [lm], ΣA_n – the sum of all room surfaces [m^2], and ρ_{sr} – is the middle factor of room surface reflection.

The value for the middle factor of room surface reflection is calculated:

$$\rho_{\text{sr}} = \frac{\sum \rho_n \ A_n}{\sum A_n} \tag{6}$$

where ρ_n is the factor of surface reflection A.

Lighting strips

Lighting strip represents a series of lights that can be sustained (continuous) or interrupted (discontinuous). The discontinuous series is observed as a lighting strip only if the longitudinal distance between the transverse centerline of individual lamps is not larger than 2/3 of the mounting of lighting strips above the usable area.

The direct horizontal lighting component (fig. 3) in the observed point, obtained by the operation of the lighting strip can be calculated as:

$$E_{\text{h}} = \frac{\pi I_\gamma}{2 h_{\text{p}}} \cos^2 \gamma \tag{7}$$

or

$$E_{\mathrm{h}} = \frac{\pi I_{\gamma}}{2\,h_{\mathrm{p}}} \cos\gamma \tag{8}$$

where I_{γ} is the light intensity of the lighting strip under the angle γ [cd], h_{p} – is the vertical difference between the lighting strip and the point and d – is the distance betweeen the lighting strip and the point.

The value I_{γ} is obtained from the diagram of the distribution of the lamp's light intensity and must be reduced to 1 m length of the light source. For fluorescent lamps with bare tubes I_{γ} value is calculated as:

$$I_{\gamma} = \frac{\Phi}{9.25} \tag{9}$$

The illumination at the ends of the lighting strip equals half the value of the calculated lighting of the central part of the strip.

The direct vertical lighting component (fig. 4) on the vertical plane is calculated according to the formula:

$$E_{\upsilon} = \frac{\pi I_{\gamma}}{2h_{p}} \cos\gamma \sin\gamma \tag{10}$$

or

$$E_{\upsilon} = \frac{\pi I_{\gamma}}{2a} \sin^{2}\gamma \tag{11}$$

where a is the horizontal difference between the lighting strip and the point.

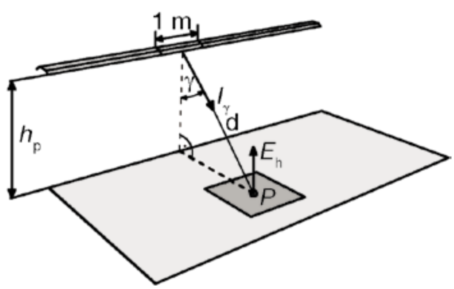

Figure 3. Illustration of the calculation of the value of the horizontal component of the direct lighting component at the lighting source in shape of the strip

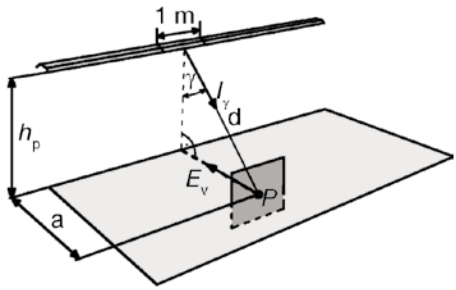

Figure 4. Illustration of the calculation of the value of the vertical component of the direct lighting component at the lighting source in shape of the strip

Genetic algorithms as the optimization method

Genetic algorithms incorporate the principles of natural selection and evolution, which have become a very powerful stochastic optimization method that is allocated from a large group of similar methods because of its performance. Genetic algorithms are an extremely efficient and flexible method that can be applied in many different applications, whether it is dealing with continuous or discrete, linear or nonlinear optimization problems with or without restrictions [19].

Genetic algorithms, in contrast to other algorithms that deal with a single potential solution, start the search from a set of potential solutions. This is followed by a process of evolution of the population by applying genetic crossover operators and mutation in the selective environment where only the best adapted individuals survive, which makes genetic algorithms less vulnerable to falling into the local minimum, in contrast to many algorithms that have this problem.

Each individual represents a potential solution to the problem which is processed and represented in the same data structure. These individuals are called chromosomes. A set of individuals is called the population. In the initialization process the initial population of individuals is generated in the field of solutions. Each individual is assigned with a certain measure of quality called kindness, which is defined with the kindness function or the objective function. In the process of forming a new population of individuals, the individuals from older populations are subjected to the influence of genetic operators. The characteristics and properties of several individuals (parents) to new individuals (offspring) is combined and transferred by crossing, while mutation changes a smaller part of the genetic material of the selected individuals (offspring). The new population is formed from the old one, by selecting of individuals whose measures of quality or adaptation are the best. The procedure stops after the evolution of the desired number of generations or achieving a satisfactory solution, and the best member of the current population represents the solution that should be close to the optimum [20-23].

Chromosome: The potential solution to the problem is called the chromosome. The chromosome is a coded representation of all the solution parameters. It can be any type of data structure (number, string, matrix...) that uniquely describes the individual. For each data structure the genetic operators must be defined so that they do not create new individuals which represent solutions that are impossible.

Population: Unlike other algorithms that manipulate one potential solution to the problem, genetic algorithms manipulate a collection of potential solutions, called the population. The population of potential solutions $P(t)$ is represented with VEL_P vectors, where t is the time or number of the generation.

The initialization process is generating the initial population $P(0)$ mostly at random from the domain of solutions and may be as a result of some other methods.

Kindness function: Kindness function is a criterion function for which the optimization of the input parameters is performed.

Selection: In order to preserve and transfer the good qualities to the next generation of individuals the selection is used.

The selection is the process of selecting individuals from the existing population, which will be crossed with each other in the next step of the genetic algorithm which will preserve the good genetic material and transfer it to a new generation while the bad disappears. The process of selection could be realized by selecting the best individuals from the population which can lead to premature convergation and undesired solution in loosing the good genetic material which some bad individuals carry.

Depending on the applied selection, the genetic algorithms are split into generation and elimination. The generation selections use one population in a single iteration and elimination selections use two populations. Typical representatives of the first type are a simple and tournament selection and the second type are the elimination selection.

Tournament selection: Genetic algorithms with an implemented tournament selection genereta a new population from the old one in each step, by selecting *VEL_P* times k individuals from the old population with equal chances. A "tournament" is organized between them and the individuals which win will be affected with the genetic operators in the next step. The probability of winning for the individual is proportional to its kindness.The elimination tournament is selecting the k number of individuals m times, eliminates the worst and replaces it with a child of the two surviving randomly selected individuals. The parameter k is called the size of the tournament.

Elitism: Since the genetic algorithm is stll an artificial and commanded system of the evolution of a population, it is possible to make the choice of a certain number of individuals within it and transfer them directly into the next generation. The aforementioned process is called elitism and ensures the protection of the best individuals from any changes or elimination during the process of evolution.The genetic algorithm with a built-in elitism mechanism tends asymptotically towards the global optimum in the generation, ie the solution of the problem. In order to protect the best individual in each step of the evolution it is necessary for the algorithm to find it. The search requires additional CPU time so that can slow down the algorithm.

Crossing: The crossing is a genetic operator of higher order which forms new individuals by combining the genetic material of several individuals. By crossing the properties and characteristics of individuals are transferred from parents to children .It is applied to selected pairs of individuals whose probability of crossing is equal to the level of crossing $p_c \in [0,1]$. The process of crossing begins by generating random cross values $\xi \in [0,1]$. If $\xi > p_c$ there is no crossing, otherwise the mask is created and the exchange of genetic material between chromosomes is performed. The main differences between the crossing operators originate out of the ways of creating masks.

Mutation: Unary genetic operator that is used for introducing new genetic material into existing chromosomes is called a mutation. The mutation is performed with a certain probability p_m known as the mutation level.

The mutation operator can prevent the population to converge to a local minimum and end in it. If the value of the mutation level is closer to one, the genetic algorithm has the characteristics of random searches. As the probability of mutation is smaller, smaller is the probability of finding a global optimum. However, in order for the good chromosomes obtained by crossing not to be lost the degree of mutation is usually kept low.

The parameters of the genetic algorithm: The basic implementation of the genetic algorithm has the following parameters: population size, number of generations (iterations), crossing probability and mutation probability.

The optimization of genetic algorithm parameters is a complicated procedure and demands a large number of experiments. Different algorithm parameters provide different results, faster or slower reaches better or worse solutions. The idea of parameter optimization is reduced to the realization of the genetic algorithm on top of a genetic algorithm, which execution would be conducted in parallel. The individual represents a group of parameter values and the kindness function could be defined in the following manner:

$$kindness = \frac{a}{T_{uk}} + bs$$

where T_{uk} is the total time of the optimization process, s – the mean deviation from the correct answer, and a and b – are the parameters that define whether the algorithm should run faster or more accurate.

The parameters of genetic algorithm may not be constant in the process of evolution, but may be a function of time or number of past iterations. Holland suggests that the genetic algorithm is applied as s preprocessor in the process of objective function optimization.

A one-dimensional problem in which the length of a chromosome is *Nb* bits, is equal to an *n*-dimensional problem where the chromosome length is *b* bits [24].

System modeling and simulation

Computer simulations of energy efficiency in buildings proved to be very useful in the analysis of daylight [25]. The applications that support detailed simulations of the buildings energy performance incorporate a set of mathematical models to quantitevely respond to the answer how each component of the system acts in a set of circumstances. They became a widely accepted method and can be particularly useful during the phase of designing the business and residential buildings.

The work on lighting simulations can be divided into two phases. The first phase is consisted of a dynamic assessment of daylight that is available on the premises, and other is consisted of control implementation for the level of dimming lights to be calculated and additional lamp consumption, according to the selected time interval.

The aim is to increase energy efficiency of the dimmable lighting system in a typical room.

In this chapter will be given an overview and analysis of the results obtained by genetic algorithm control based on mathematical models of a particular lighting system. The mathematical model and genetic algorithm have been developed and tested in the software package MATLAB.

Lighting system

Customers around the world require an increasing degree of sophistication and lighting technical performance, as well as a modern environment that is becoming more creative in ways of using the lights. Professional solutions require accurate assessment of all influencing factors. Lamps and control gear devices manufacturers offer and propose a number of software packages for support of users in their choice of products during the design solutions.

The number of lamps and their position was roughly calculated using the lumen method CalcExpress application [26], based on the characteristics of the room, and lights presented in tab. 1. The selected lamps MENLOSFT SR 3X24W HFS DMB WL5 L840 were fitted with three Fluorescent T5 tubes and high-frequency digital ballast that is located in the 5 W power control gear. With this configuration, the mean horizontal illumination is 543lx obtained from the lighting system without compromising from natural light. It is adopted that for measuring the levels of horizontal illumination in points on the desktop four photo-sensors are used where each is equally distanced from four adjacent lights as shown in fig. 5.

Better uniformity, higher energy savings and cheaper initial investment in this step could possibly be achieved by genetic algorithms for optimal design of mounting height and layout of lamps that may have different characteristics [27].

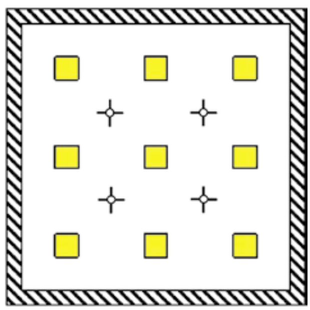

Figure 5. Individual arrangement of lights and sensors

Table 1. Calculation of lighting using the lumen method

Room dimensions [m]	length	7
	width	7
	height	3.5
Height of work surface [m]		0.75
		1.31
Reflection factors	ceiling	0.9
	walls	0.9
	floor	0.4
Light source	type	fluorescent tube T5 24W
	nominal luminous flux [lm]	1750
Lamps	number of light sources in the lamp	3
	the total adopted number of lamps	9
	the distance between [m]	2.33
	length [m]	0.6
	width [m]	0.6
	height [m]	0.17
Lighting efficiency		0.84
Factor of pollution and aging		0.67
The total luminous flux [lm]	dimming level 100%	47250
The actual mean brightness [lx]	direct	274
	indirect	269
	total	543
Electrical power [W]	lamps	72
	ballasts	5
The installed electric lighting power [W]		693

Mathematical model of the system

The distance from any lights' center to points on the working surface in which the level of brightness is regulated is more than five times larger than the largest lamp dimension. According to that, the direct component of horizontal light that the sensors would measure is possible to be accurately determined using the point method based on expressions (1) and (2). The mathematical model includes indirect (reflected) light component, eq. (5). In practice, it is dominant in relation to direct, but much lower than in theory, therefore, its impact is three times weaker in operation. The system is multivariable, it has nine inputs and four outputs. The inputs are variable light intensities for which it is assumed to be directly proportional to the luminous flux of lamps.

Daylight

Daylight is essential for improving energy efficiency and visual comfort. An essential step in the evaluation of these goals requires an accurate estimation of the amount of natural light at any point in the closed space. Typically, the light emitted by natural sources is often determined in accordance with the daylight factor calculations based on the cloudy weather, in order to watch the most unfavorable weather conditions for the broadcast of daylight.

Tregenza *et. al.* [28] proposed the concept of daylight coefficient which takes into account the change in brightness of sky elements that provides a more efficient way for calculation of lighting in areas under different weather conditions and solar locations. The level and distribution of sky brightness are essential for determining the daylight coefficient and such measurements were conducted at numerous sites [29]. CIE (engl. International Commission on Illumination) [30] adopted the 15 standard sky types that have been proposed and they cover all the possible spectra in the world. The daylight coefficient gives much more accurate results than the traditional methods of daylight factors, especially when the weather is clear [31]. The sky is treated as a series of point sources, so that the daylight coefficient can be applied for calculation of the direct light component that comes from these sources, as well as internal reflected components (from the sky and earth), because of which it is used in systems with complex optical properties. Advanced computer technology can reduce the time required for the calculation of light due to the different position of the sun and sky types.

By using the applications such as: DIALUX, RELUX, ECOTECT, SUPERLITE, ADELINE, RADIANCE, DDS, INLUX [32] and so on, it is possible to estimate the level of daylight on the work surface and inner walls, and then the energy saving by integrating dimmable lighting systems which uses the daylight. In many studies dealing with daylight SUPERLITE and RADIANCE are particularly present and they are generally seen as the basis for calculations and analysis of the results of other programs, as well as the daily determination of factors and coefficients for which RADIANCE is mainly used [33, 34]. Here only diffuse component of daylight is usually observed, which prevails over the discrete which is causing glare and the need to use protection on the windows. The disadvantages of most of these applications are primarily the complexity that requires a lot of time to overcome, the input data which is not typical in daily measurements and physical limitations of the model in order for accurate simulations to be performed. Studies have however shown that the professionals in this field use their own calculations with simple design tools to predict the dynamics of daylight [35]. The paper uses the assumed sinusoidal changes of daylight from the 600-800lx which approximately obtains the mean level of natural light measured offices across Europe from 431lx without the use of electric lighting [36]. Daily changes in the operation are calculated from 8:00-18:00 h, with a period of change in natural light, which is set in the function *luxControl*. The implementation of changes is given in the file *daylightIllumination.m*.

Newer methods for predicting the daylight on the work surface under any weather conditions have the accuracy of ±20lx [37]. It was displayed that artificial neural networks can provide acceptable accuracy for this purpose, but it takes a lot of input data such as solar radiation, ambient temperature, humidity, ultra-violet radiation, the number of windows, window distance, room orientation, room dimensions, and so on [38].

EnergyPlus, a generally accepted tool for building energy simulation, allows a detailed analysis of the energy performance of business-residential buildings, including lighting, based on weather data and realistic models of buildings [39].

Realization of the control algorithm

The genetic algorithm for the system of dimmable lighting was developed using the MATLAB application. The structure of the program is: the main function, *luxControl*, that after the system initialization (mathematical model loading, the characteristics of the premises and parameters of the genetic algorithm) based on input parameters (number of days, a period of daylight changing in minutes and the desired brightness value), function calls for the prediction of daylight, genetic algorithm, the function for on-off control, calculation of the reflected component and the current consumption of the system; the functions in which the genetic operators (selection, crossing and mutation) and the kindness function are implemented.

The genetic algorithm always starts the stochastic search for potential solutions with an initial population that is generated in a random way. The individuals in the population contain coded values of intensity of light from the lamps, from 0-100%. The tournament selection is applied on the population, as well as the complete arithmetic crossover and random mutation operator. The selection separates the chromosomes with a minimal value of the objective function criterion. The rating of adjustment of individuals is corresponding to the maximum deviation from the actual desired level of horizontal lighting that would be obtained in one of the sensors.

Experimental results

The provision of appropriate lighting of working areas is recognized as a significant contribution to comfort and productivity [40]. The space (room) is any area which requires a minimum and medium brightness guarantee regulated by technical and health standards. The current European standard EN 12464 [41] defines the value of light for many activities that are performed in business-residential buildings. So 500lx needed for the smooth operation at the table – reading, writing, typing, data processing.

The basic requirements which have to be met by any system of dynamic lighting are: achieving the desired level of brightness and uniformity in the room and energy savings. The uniformity is displayed here as the mean relative deviation of actual from the desired brightness value of each sensor and if the natural light is larger than the desired, the genetic algorithm tends to keep it at the same level using the kindness function.

Table 2. The parameters of the genetic algorithm

Name	Value
Population size	50
Number of iterations	500
Crossing threshold	0.7
Mutation threshold	0.3

The parameters of the genetic algorithm presented in tab. 2 are determined in the experimental way. A series of simulations has been performed with the lighting reference values of 500lx and daylight changes every 10 minutes, from 8:00 to 18:00 h. An example of a genetic algorithm is displayed in tab. 3.

The analysis of energy savings was performed by comparing the consumption of the conventional system when the lights were dimmed 100% throughout the study period from 8:00 to 18:00 h, with consumption when using daylight and on-off control and daylight and continuous dimming lights using genetic algorithms. Table 4 presents the data of the average daily consumption obtained as a result of a series of simulations, for these input parameters.

Table 3. The example of operation of the genetic algorithm

Iteration	Sensor 1 [lx]	Sensor 2 [lx]	Sensor 3 [lx]	Sensor 4 [lx]	Error [lx]
1	672.7801	692.5490	706.0786	672.6656	206.078
10	628.1336	627.8615	631.4321	648.4998	148.499
20	581.1053	591.1092	547.8295	594.6882	94.6882
30	533.5625	542.2310	534.2603	535.4359	42.2310
40	493.0586	502.7693	498.5909	508.0937	8.0937
50	493.3022	503.0639	498.9102	506.0281	6.6978
60	495.8539	504.0477	499.4967	503.1167	4.1461
70	496.2492	503.8553	497.7595	500.4080	3.8553
80	496.3690	503.4400	500.0861	501.8455	3.6310
90	497.0090	502.9961	502.7088	500.2640	2.9961
100	497.9576	501.9783	499.8928	498.0405	2.0424

Table 4. Daily consumption and energy savings

	Avg. daily consumptions	Savings
Conventional system	6.48kWh	/
On-Off control	1.8kWh	72%
Genetic algorithm	2.38kWh	63%

As expected, the biggest savings was provided by on-off control (72%), but in this case the daylight affects the frequent on and off lights and thus can significantly reduce their lifetime, while the requirements for uniformity, *i. e.* uniformly horizontal illumination cannot be met unless the impact of natural light considerably smaller than the desired level. These deficiencies can interfere with the people present and create high light intensities that are not necessary.

Based on the obtained results it is concluded that the genetic algorithm can meet the high demands of regulating lighting levels by dimmable lighting control, since the error of lighting regulation is ±8lx. A high level of uniformity and energy savings of 63% has been achieved, with a relatively small number of iterations. At the same time the reduction of CO_2 emissions by 63% has been achieved (0.43 kg per kWh).

If higher electricity savings are desired, the integral part of the lighting system without which they cannot be imagined are the presence (movement) detectors. Further savings of up to 20% were determined by measuring the possibility of their use [42]. Thus, the people's absence or activities in the room is a very important stochastic process that can decrease the power consumption. The paper doesn't cover that, but it can be implemented in the simulation using the inhomogeneous Markov chains [43] in order to improve the control algorithm.

Discussion of results – comparison with related works

There's many different approaches that focuses on lighting control in offices. As mentioned previously, control using occupancy sensor can by itself reduce consumption – for 20%

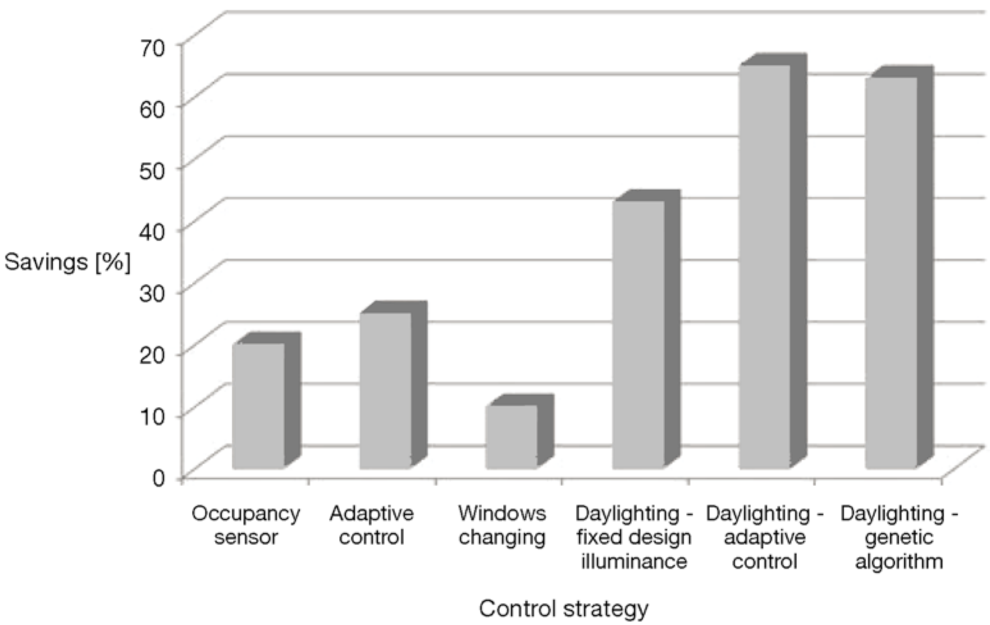

Figure 6. Comparison in achieved savings between different control strategies

or more [44]. Adaptive control, based on occupants behavior and desired lighting level, earns savings of 25% [45], while changing window system (different dimensions and glazing) can achieve about 10% of savings [46]. When it comes to papers which are also oriented towards daylighting, most of them also concludes that savings varies from 40% up to 80% [47, 48], but with control strategies that, as stated, are highly sensitive to the changes in occupancy patterns. Applied genetic algorithm, with all its advantages and estimated savings of 63%, is on the one hand a highly competitive to other solutions (fig. 6), while on the other hand easily adaptable and resilient to changes in the system.

Conclusions

In the upcoming period the growth in prices of energy and energy sources prices will be continued and this will directly affect the rising of costs of living and doing business. Therefore, the priority is given to sustainable energy, through rational planning and implementation of energy consumption efficiency measures in all segments of the energy system of the country, followed by the adoption of new legislative regulations and standards, which are standardizing and regulating the energy consumption of buildings and issuing energy certificates based on the determined energy performance environmental standards. Numerous studies show great importance of daylight in the business-residential buildings. Natural lighting has a positive impact on increasing the mental and physical abilities. The sunlight as a renewable energy source can be used to improve the energy efficiency of the integration of lighting control systems in office buildings.

A genetic algorithm for the control of lighting by continuous light dimming was realized in this paper. By using the MATLAB application it was tested based on the designed mathematical model and the assumed daylight changes. The mathematical model allows accurate calculation of the horizontal lighting at any point in the room on the work surface due to the effect of lamps and light reflection from the walls, floors and ceilings. Based on the obtained results from a series of simulations it can be concluded that they met the needs of regulation, especially the accuracy of the response system.

The modern world of lighting is complex and expert. In the near future, a number of factors will influence the development of products for lighting. Product improvement will be even more expressed, and trends such as miniaturization, energy efficiency, ease of use, comfort, light quality and many others will lead to the development of new products. The increasing demands for reducing greenhouse gases in light bulbs, by reducing or eliminating hazardous substances such as mercury or lead, and mandatory recycling of old products. The light emitting diodes (LED) will get a much more significant role in various applications. The increased use of electronics in lighting will be noted where the electronic control devices will be more frequent than they are today in the household as well as professional applications, while the revolution in digital technology will continue its influence.

The integration of automatic lighting control in office buildings offers high quality lighting, improved lamp life, increase of system efficiency and flexibility in use. The environmental responsibility is met as one of the basic guidelines of modern society in the form of reduced energy consumption, increased use of renewable energy sources, reduction of CO_2 and other greenhouse gases emission. The lowest investment costs and maintenance in office buildings is needed preciselcy in lighting systems, which provide the greatest savings in power consumption compared to other subsystems.

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