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MULTIMEDIA TECHNOLOGIES FOR THE STUDIES OF OPTIMAL CONTROL SYSTEMS

Mosashvili Ia, Sesadze Valida, Maglakelidze Nana
Georgian Technical University

S u m m a r y

Multimedia is already widely used in Georgia and its use increase well in future. Nowadays there are new possibilities to represent the teaching process better. Multimedia approach used for studying the course "Theory of Optimal Control". It must contain the projecting of pedagogical conception and to bring it to the appropriate model of the material, which we have already realized. Studying the control process in current time using multimedia facilities helps a student to imagine the optimal control task and to resolve it in different ways. The task, which is the best according to its high-speed response, represents the task of designing the optimal trajectory. The task on soft landing on the Moon refers to the above-mentioned tasks. In this task, the equation of artificial satellite soft landing on the Moon is formulated with the initial conditions.

Key words: Multimedia. Teaching process. Optimal Control System..

1. Introduction

Multimedia is implanting in various fields, by means of which is almost impossible to differ the model created for computer model from real. The status creation of computer arrangements is directed to that the students who use it analyze and acquire it. Yet from the motor of creating computer it was an idea to use its program of computer providence in the teaching process.

The use of computer potency in education is developing quickly and promises the increasing of the quality of studying process. Computer graphic enables the students to make an experiment of "soft landing" themselves and to choose the optimal variant among the results.

To make a model of any object is very difficult that is connected with great material problems. That's why the problem of the objects visualize is possible to solve by means of computer. It's much easier in this case it's possible to make some changes in model, to observe the heavier of the object in various conditions and so on.

Now days there are new possibilities to represent the teaching process better. A student can study theoretical material and conduct laboratory experiments without changing place. When we project the Multimedia model it must be taken info the consideration both pedagogical side the modernization of multimedia methods can give the possibility of using with potentials of traditional teaching process. Teaching methods must be near to adapted teaching ways and style. Teaching by this way can be conceptual and profound. A customer sees visually all the models of product, by which he (she) can learn understand the definite side that interests him (her). As for profound teaching it contains more actual materials of teaching. It relies upon the theories, examples, and demonstrative parts. It contains multimedia technologies with animation, visualization and other.

2. Basic part

For example, let us assume that the landing on the Moon is performed in a vertical direction. Let us say that shuttle m_0 starts to fly with the starting mass.

Because of fuel run out, shuttle mass $m(t)$, as a rule, changes:

$$\dot{m}(t) = -u(t),$$

Where $u(t)$ - is the fuel rate per second.

The following factors affect the shuttle, the gravity:

$$p = m(t) \cdot g \text{ ;}$$

Resistance force Q and attractive force F :

$$F = \beta u(t); \quad Q = c v^2(t),$$

Where $v(t) = \dot{y}$. c and β parameters are constant. They depend on the shuttle construction.
Let us write the equation of the soft landing in the following way:

$$\left.\begin{aligned} \dot{y} &= v \\ \dot{v} &= \frac{\beta u(t)}{m} - g\pi \\ \dot{m} &= -u(t) \end{aligned}\right\} \tag{1}$$

conditions:

$$y(0) = y_0;\ v(0) = v_0;\ m(0) = m_0.$$

The last moment T, which is unknown beforehand, must be determined from the following conditions:

$$y(T) = 0;\ v(T) = 0.$$

In equations (1) $g\pi$ is the speed of free fall on the Moon and is equal to 1.62 m/sec^2. To choose the control $u(t)$ is needed, which shows us the fuel rate per second, so that we could bring the fuel consumption to minimum in the landing presses.

$$J(u) = m_0 - m(T) \to \inf \tag{2}$$

$$0 \le u(t) \le u_{\max} \tag{3}$$

The process of control consists of 2 levels:

1). Free fall from the *t=0* moment, to the $t = t_1$ moment, at $U_{opt}(t)=0$.

2). Braking in interval $[t_1, T]$, at $U_{opt}(t)=U_{\max}$.

The function of the main engine is to provide the program control in the task.

$$\left.\begin{aligned} &\dot{z}_1 = z_2 \\ &\dot{z}_2 = \frac{\beta\omega(t)}{z_3} - g\pi \\ &\dot{z}_3 = -\omega(t) \\ &z_1(0) = z_{10};\ z_2(0) = z_{20} \\ &z_3(0) = z_{30} \\ &z_1(T) = z_{11} > 0 \\ &z_2(T) = z_{21} > 0 \\ &J(\omega) = z_3(0) - z_3(T) \to \inf \\ &0 \le \omega(t) \le \omega_{\max} \end{aligned}\right\} \tag{4}$$

Here z_{11} and z_{21} - are the specified values, control $\omega(t)$ provides the main engine braking.

The second circuit of the control is provided by miror engines. Let us use indignant values x_1, x_2, x_3 so that:

$$y = z_1 + x_1;\ v = z_2 + x_2;$$
$$m = z_3 + x_3;\ u = \omega + \xi.$$

At first approximation to the indignant values, we will get:

$$\begin{aligned} y &= z_1 + x_1;\ v = z_2 + x_2; \\ m &= z_3 + x_3;\ u = \omega + \xi. \end{aligned} \tag{5}$$

The initial conditions for equation (5) are determined by obtained exact program control(4). We may consider that the initial conditions show the produced value themselves - $y_{10,}\ y_{20,}\ y_{30}$ - with satis factory conditions:

$$\alpha_1 y_{10}^2 + \alpha_2 y_{20}^2 + \alpha_3 y_{30}^2 \le R^2,$$

(6)

Where R is the value which determines the exactness of program control.

Naturally, as the minimum degree of the functional is taken the functional which describes the exact condition of "soft landing" process:

$$\left.\begin{aligned} &J_1(\xi) = (z_{11} + y_1(T_1))^2 + \alpha_4 (z_{21} + y_1(T_1))^2 + \alpha_5 y_3^2(T_1) \to \inf \\ &0 \le \xi \le \xi_{\max} \end{aligned}\right\}$$

(7)

Here $T_1 -$ is the moment of soft landing unknown; α_i - is the comparative coefficient of balance.

It is necessary to find the C control in tasks (5)-(7), $\xi = \xi(y_1, y_2, y_3)$. Also, it is important to note that tasks (5) - (7) and equations (4) are independent and should be solved together.
Generally, in the task solving, the common recourse of fuel (Q) is discharged.

According to the abovementioned, the following conditions should be fulfilled:

$$\omega_{\max}(T - t_1) + \xi_{\max}(T_1 - T) \le Q$$

(8)

Besides this, the exact program control performance is determined by the value in inequality (6) and the minimum value of $J_1(\xi)$, mainly the sense of speed in the soft landing process.

3. Conclusion

This task of multimedia concepts the usage of multimedia methods and the theoretical and practical study of one of the main method-maximum principles the optimal operation. The structure is selected so that its possible an independent study of different parts. A student can realize well the main principles of optimal operation and get to know landing on the moon softly. This task is the task of optimal operation, we review here the task of extremal operation.

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УЧЕБНАЯ МУЛЬТИМЕДИЙНАЯ ПРОГРАММА ПО ИЗУЧЕНИЮ ТЕОРИИ ОПТИМАЛЬНОГО УПРАВЛЕНИЯ

Мосашвили И.О., Сесадзе В.К., Маглакелидзе Н.И.

Грузинский Технический Университет

Резюме

Компьютерные технологии проникли практически во все области человеческой деятельности. Одним из наиболее перспективных направлений применения компьютерных технологий в учебном процессе является создание мультимедийных электронных учебников. В связи с непрерывным возрастанием нагрузки на преподавателей ВУЗа сокращается время живого общения каждого конкретного студента с преподавателем. Вследствие этого усиливается роль самостоятельной подготовки студентов. Самоподготовка студентов по большинству технических дисциплин возможна только с помощью печатных материалов (книги, учебники, периодические издания), что требует усиленной концентрации внимания и большого количества времени и при этом не обеспечивает обратной связи с читателем. В то же время известно, что общение в процессе обучения помогает усваиванию материала. Электронное учебное пособие в виде интерактивных мультимедийных обучающих программ, которые включают в себя гипертекст, иллюстрации, видео и звуковые фрагменты, сочетают в себе наглядное представление материала и общение с обучаемым.

სასწავლო მულტიმედიური პროგრამა ოპტიმალური მართვის სისტემების შესწავლისათვის

ია მოსაშვილი, ვალიდა სესაძე, ნანა მაღლაკელიძე
საქართველოს ტექნიკური უნივერსიტეტი

რეზიუმე

სასწავლო პროცესში მულტიმედიის მეთოდების მოდერნიზაცია იძლევა ტრადიციული სასწავლო მეთოდების პოტენციალით სარგებლობის შესაძლებლობას, მარტივს ხდის შედარებას განსხვავებულ მოდელებს შორის. სტუდენტი ვიზუალურად ხედავს ყველა მასალის მოდულს, რითაც მას შეუძლია ისწავლოს, გაიგოს გარკვეული მხარე, რაც აინტერესებს. შესაბამისი ინსტრუმენტების გამოყენებით მომხმარებელი მონიშნავს მოდულს, სწავლების მიზანს და სწავლების სტილს. ის იტევს სწავლების უფრო აქტუალურ მასალებს, დაყრდნობილია თეორიაზე, მაგალითებზე, სადემონსტრაციო ნაწილებზე, მოიცავს მულტიმედიურ ტექნოლოგიებს ანიმაციების შემცველობით, ვიზუალიზაციას და სხვა. მულტიმედიური პაკეტების ტექნიკური მხრიდან ყველაზე მნიშვნელოვანი არის ხელმისაწვდომლობა და პროდუქტის მოხმარების სიადვილე. მაღალი ხარისხის მულტიმედიურ პროდუქტთან მუშაობა არის გაცილებით ადვილი და სწრაფი, ვიდრე სხვა მასალებთან. ობიექტის თვალსაჩინოების პრობლემის გადაწყვეტა კომპიუტერის საშუალებით გაცილებით იოლია. ამ შემთხვევაში შესაძლებელია სხვადასხვა ცვლილებების შეტანა მაკეტში, სხვადასხვა პირობებში ობიექტის ყოფაქცევაზე დაკვირვება და სხვა. ამ მიზნით შექმნილია მულტიმედიური პაკეტი: „ოპტიმალური მართვის თეორია“ (მთვარეზე რბილად დაჯდომის მაგალითზე). აღნიშნული მაგალითისთვის ოპტიმალური მართვა განხორციელებულია პონტრიაგინის მაქსიმუმის პრინციპის გამოყენებით.