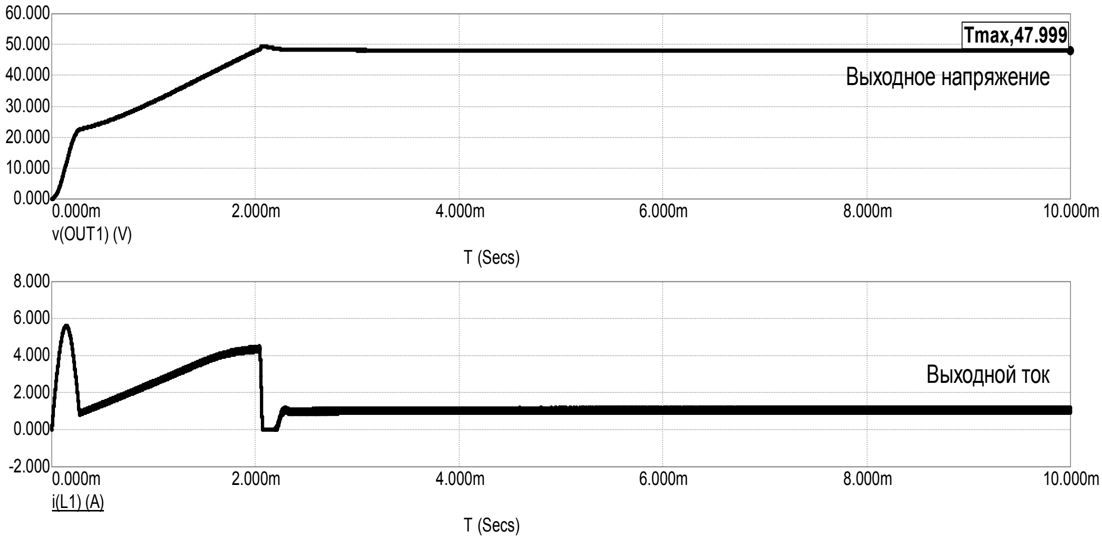

Рис. 3. Временные диаграммы работы стабилизатора

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SIMULATION OF ANT ALGORITHM USING MAPLE WITH ADDING ADDITIONAL PARAMETER

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In this work we compare time used to process the Ant algorithm with additional parameter and without it.

One of the methods to solve optimization tasks is so called “Ant algorithm” [1]. Original author’s (Marco Dorigo [2]) algorithm description contains four parameters, which regulate speed of convergence and precision of optimization process. Ant algorithm [3] is implemented using mathematical computer software Maple [4, 5]. In this current work we’re trying to determine appropriateness of adding one more parameter. We’ll be comparing time used to process the algorithm with additional parameter and without it. Function **time** is used to calculate used processor time by the software. Results may vary on different computer configurations.

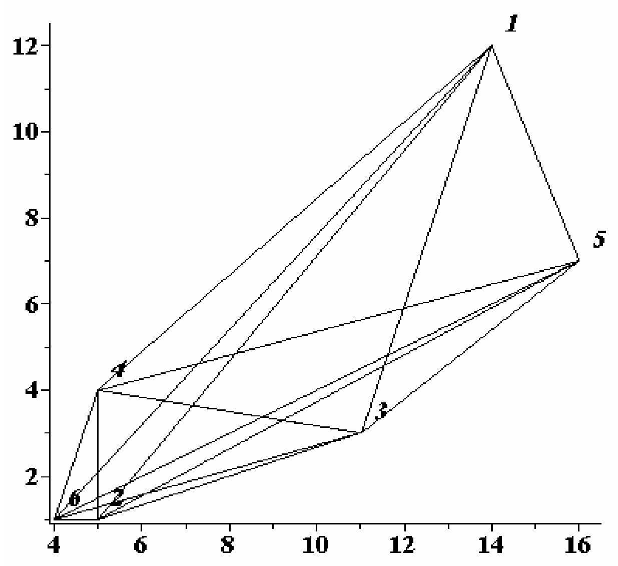

Fig. 1. Ant algorithm, *n*=6

We're solving traveling salesman task about finding shortest simple cycle in full graph with n vertices, which we'll call cities. Simulation of ant behavior is formed by pheromone distribution on the road, which is proportional to the route length (the shorter the route, the more pheromone is stored on it, which is an α parameter). Besides that, the probability of choosing the specific route is declared as inversely proportional to the distance between cities (β parameter). To prevent early convergence of algorithm to false result, the algorithm's author added negative feedback – pheromone drying (the third parameter). Fourth parameter is the number of elite ants. They're acting using greedy algorithm, which is just selecting the best way (random number generator aren't used here).

Now we're adding additional parameter (for which we use γ) and one variable «survival». We'll use Ψ for it, it'll be random for each path between cities $\psi_{ij} = \frac{rand(1..100)}{100}$. Probabilistically-proportional rule will look like:

$$P_{ij,k}(t) = \frac{\tau_{ij}(t)^{\alpha}(1/d_{ij})^{\beta}\psi_{ij}^{\gamma}}{\sum \tau_{ij}(t)^{\alpha}(1/d_{ij})^{\beta}\psi_{ij}^{\gamma}} . \quad (1)$$

Pheromone renewal will be done using formula: $\tau_{ij} = (1-\rho)\tau_{ij} + \Delta\tau_{ij}$, where $\Delta\tau_{ij} = \sum \frac{Q}{L_k(t)}$ (sum is calculated for traversed path), ρ – pheromone drying intensity.

From the next comparing table (α=0,5, β=5) it is clear, that algorithm processing time is not improving, moreover processing time is rather increasing in some way. But this can be explained as the result of additional time needed to process another random numbers generating function.

Table 1

γ	t	Lmd
0	0.406	36.923
1	0.437	37.592
2	0.437	38.779
3	0.437	39.757
4	0.452	40.548
5	0.437	40.865

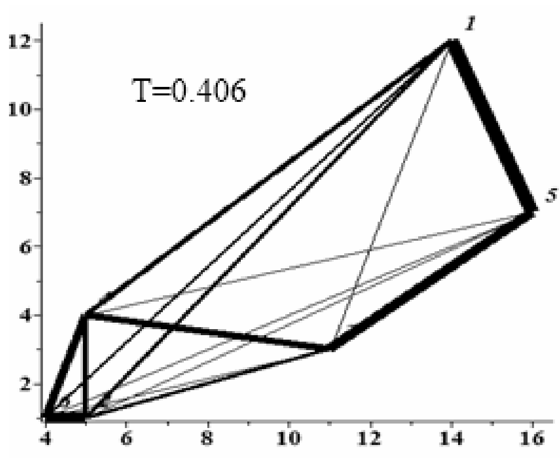

Fig. 2. Optimal route, $\gamma = 0$

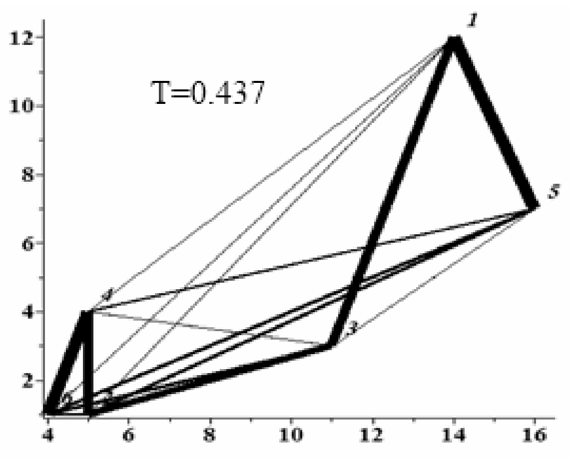

Fig. 3. Optimal route, $\gamma = 5$

The route itself can differ. By changing α, β, γ we can probably achieve better results.

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