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P-ALGORITHM METHOD MODIFICATION

There often occurs a task to place the sources of physical field on the fixed seats. Such problems are common at production (the optimal placement of pollution sources, sound, etc.), at radio engineering apparatus design (the provision of circuit optimal temperature mode), at searching the optimal placement of oil wells and so on.

The task formulation.

There is an area $\Omega \subset R^n$; with N sources of physical fields $D_i, i \in 1:N$; N seats $n^j \in \Omega, j \in 1:\mathrm{N}$ and K of control points. It is needed to place the sources of physical field on the fixed seats in such a way to obtain the maximum field value from the field at the control points and to make it become minimum one. Every source should occupy one seat only and one source has to be available for one seat.

The physical field which is created by the placed sources and the boundary conditions on the area Ω is described with the task of mathematical physics.

The mathematical model of the task.

The controlled variables.

$$x_{ij} = \begin{cases} 0, \text{ if the } i-\text{source is not available for } j-\text{seat} \\ 1, \text{ if the } i-\text{source is available for } j-\text{seat} \end{cases}$$

The limitations.

$$\begin{cases} \sum_{i=1}^{N} x_{ij} = 1, j \in 1:\mathrm{N}, \\ \sum_{j=1}^{N} x_{ij} = 1, i \in 1:\mathrm{N}, \end{cases} \qquad (1)$$

$$x_{ij} \in 0,1, i \in 1:\mathrm{N}, j \in 1:\mathrm{N}, \qquad (2)$$

The purpose of the function.

$$f\ x = \max_{k \in 1:K} f_k\ x \to \min, \qquad (3)$$

where $f_k\ x = \sum_{i=1}^{N} \sum_{j=1}^{N} c_{ij}^k x_{ij}$, c_{ij}^k – is the role of *j*- source, which is placed on the *j*- seat of the field value at *k* control point.

Computation scheme of P-algorithm metod.

1. The initial basis $\bar{x}_0^0$ is selected. The point corresponds to x^0. $s = 0, r = 0$.
2. Suppose there is the basis $\bar{x}_s^r$. It The point corresponds to it x^r, then:

   2.1. The multiplicity is created:

   $$K_{\max}\ x^r = k \in 1:K \mid f_k\ x^r = f\ x^r .$$

   The potentials $u_i^k\ \bar{x}_s^r, v_j^k\ \bar{x}_s^r$ and evaluation $\Delta_{ij}^k\ \bar{x}_s^r$ are found $\forall k \in 1:\mathrm{K}$ for

$\overline{x}_s^r$.

2.2. If there is no positive evaluation for at least one $k \in K_{\max}(x^r)$, then $x^* = x^r$ is the task minimum problem. It is the end of the algorithm. Otherwise, move to 2.3.

2.3. The multiplicity of cells $I(\overline{x}_s^r)$ is found. Every element of the multiplicity satisfies the following conditions:

$$\forall k^* \in K_{\max}(x^r) \ \textit{implemented} \ \Delta_{i^* j^*}^{k^*}(\overline{x}_s^r) > 0.$$

If it is empty, then go to 4. Otherwise, move to 2.4.

2.4. The multiplicity $I(\overline{x}_s^r)$ provides the selection of the element that satisfies the following condition $f_k(x^r) - \Delta_{i^* j^*}^{k}(\overline{x}_s^r) < f(x^r), \forall k \notin K_{\max}$. If there is no such element, then go to 4. If there are several elements, then it is recommended to select the one that creates a single traffic. Let us denote it via (i^*, j^*).

2.5. The next basis is found.

3. If the traffic value is equal to one, then there is a new point x^{r+1}. It corresponds to a basis $\overline{x}_0^{r+1}$. r is increased by 1 and s obtains the value of zero. Otherwise, there is the same point x^r, but another basis $\overline{x}_{s+1}^r$. r is not changed and s is increased by 1. Then move to 2.
4. $x^* = x^r$ is the solution. x^* is the stationary point of the method.

The disadvantage of this method is that its efficiency significantly decreases with increasing number of control points. Therefore, the modified P-algorithm is developed. It possesses the optimized procedure of a cycle design and is based on the method of potentials, which uses tree structures [1].

To improve the method it is recommended to use the parallel computing in software implementation. The evaluation and the potentials are computed in parallel at every step of the algorithm.

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