CONTRIBUTIONS TO PERFECTING GRAPHIC -ANALYTICAL VARIANT OF THE METHOD OF CONTINUOUS CURRENT DESTINED TO THE IDENTIFICATION OF THE HOUR INDEX OF A THREE- PHASE TRANSFORMER

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Abstract. *The article represents a discussion on the initial graphic-analytical variant of the continuous current, used for the verification of the hour index of the connections group. There are analyzed the deficiencies of the first variant and are proposed solutions for its perfectioning.*
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Introduction

The graphic-analytical variant for the continuous current method of determination of the hour index presented at [1], has as calculation formula for the hour index, the following relation:

$$K^0 = Q + \frac{1}{30} arctg\left[\frac{0{,}86(\lambda_{bc} - \lambda_{ca})}{-\lambda_{ab} + 0{,}5(\lambda_{bc} + \lambda_{ca})}\right] \quad (1)$$

in which: Q – represents a correction coefficient;

$$Q = 3(3+\lambda_{ab}) \quad (2)$$

λ_{ab}, λ_{bc}, λ_{ca}, - represents numbers corresponding to the first line of the code matrix.

The effectuated verifications of the (1) relation, taking into consideration all the 12, outline two cases doubting :

- the case of the hour index k=3, expressed by the code matrix: $[G_3] = \begin{bmatrix} 0 & -1 & 1 \\ 1 & 0 & -1 \\ -1 & 1 & 0 \end{bmatrix}$;
- the case of the hour index k=9, expressed by the code matrix: $[G_9] = \begin{bmatrix} 0 & 1 & -1 \\ -1 & 0 & 1 \\ 1 & -1 & 0 \end{bmatrix}$.

In the first case, λ_{ab}, λ_{bc}, λ_{ca} have the following values :

$\lambda_{ab} = 0$; $\lambda_{bc} = -1$; $\lambda_{ca} = 1$.

In the second case, λ_{ab}, λ_{bc}, λ_{ca} have the following values :

$\lambda_{ab} = 0$; $\lambda_{bc} = 1$; $\lambda_{ca} = -1$.

The doubt situation is generated by the value of the constant λ_{ab}, which, for the hour index k=3 as well as for the hour index k=9, has the same value.

For the rest of the analyzed cases, the correctitude of relation (1) has been confirmed.

Perfectioning solutions

The results of the study previously presented have highlighted the necessity of reconsidering the expression of the correction coefficient. We looked forward so as the expression of Q could be applied in all the 12 possible cases. In consequence, we proposed the following expression:

$$Q = 3(3+q) \quad (3)$$

in which q is defined as it follows:

$$q = \begin{cases} \lambda_{ab} & \text{când } \lambda_{ab} \neq 0 \\ \lambda_{ca} & \text{când } \lambda_{ab} = 0. \end{cases}$$

In consequence, the final formula will have the following form:

$$K^0 = 3(3+q) + \frac{1}{30} arctg\left[\frac{0{,}86(\lambda_{bc} - \lambda_{ca})}{-\lambda_{ab} + 0{,}5(\lambda_{bc} + \lambda_{ca})}\right] \quad (4)$$

The correctitude of this expression has been verified in all the 12 possible cases (including the two doubtful ones, seized within the previous formula).

Example 1:

For: $\lambda_{ab} = 0$; $\lambda_{bc} = -1$; $\lambda_{ca} = 1$.

$$K^0 = 3(3+1) + \frac{1}{30} arctg\left[\frac{0{,}86(-1-1)}{0+0{,}5(-1+1)}\right] = 3\,.$$

Example 2 :

. For: $\lambda_{ab} = 0$; $\lambda_{bc} = 1$; $\lambda_{ca} = -1$.

$$K^0 = 3(3-1) + \frac{1}{30} arctg\left[\frac{0{,}86(1+1)}{0+0{,}5(1-1)}\right] = 9$$

Further, is presented another solution for the perfectioning of the graphic-analytical variant of the continuous current method, used for the verification of the connections group.

We start from the rationalized codes panel [2], presented in Table 1. We noticed that the codes used for the hour indexes 1, 3, 5, 7, 9, 11, are also used for the hour indexes 12, 2, 4, 6, 8, 10, thus existing the following correspondence:

Table 1

K=1

	ab	bc	ca
AB	+	-	-
BC	-	+	-
CA	-	-	+

K=2

	ab	bc	ca
AB	+	-	+
BC	+	+	-
CA	-	+	+

K=3

	ab	bc	ca
AB	+	-	+
BC	+	+	-
CA	-	+	+

K=4

	ab	bc	ca
AB	-	-	+
BC	+	-	-
CA	-	+	-

K=5

	ab	bc	ca
AB	-	+	+
BC	+	-	+
CA	+	+	-

K=6

	ab	bc	ca
AB	-	+	+
BC	+	-	+
CA	+	+	-

K=7

	ab	bc	ca
AB	-	+	+
BC	+	-	+
CA	+	+	-

K=8

	ab	bc	ca
AB	-	+	-
BC	-	-	+
CA	+	-	-

K=9

	ab	bc	ca
AB	-	+	-
BC	-	-	+
CA	+	-	-

K=10

	ab	bc	ca
AB	+	+	-
BC	-	+	+
CA	+	-	+

K=11

	ab	bc	ca
AB	+	+	-
BC	-	+	+
CA	+	-	+

K=12

	ab	bc	ca
AB	+	-	-
BC	-	+	-
CA	-	-	+

1 ⟶⟵ 12

3 ⟶⟵ 2

5 ⟶⟵ 4

7 ⟶⟵ 6

9 ⟶⟵ 8

11 ⟶⟵ 10

This observation suggests the following formula of hour index identification:

$$K^0 = [3(3+\lambda_{ab})+t]+\frac{1}{30}arctg\left[\frac{0{,}86(\lambda_{bc}-\lambda_{ca})}{-\lambda_{ab}+0{,}5(\lambda_{bc}+\lambda_{ca})}\right] \quad (5)$$

in which t is defined as :

$$t = \begin{cases} 0; \text{ for the groups } 2, 4, 6, 8, 10, 12; \\ 1, \text{ for the groups } 1, 3, 5, 7, 9, 11. \end{cases}$$

Once again, the correctitude of this expression has been verified in all the 12 possible cases.

Example 1:

For: $\lambda_{ab} = 0$; $\lambda_{bc} = -1$; $\lambda_{ca} = 1$.

$$K^0 = [3(3+0)+1]+\frac{1}{30}arctg\left[\frac{0{,}86(-1-1)}{0+0{,}5(-1+1)}\right] = 3$$

Example 2 :

For : $\lambda_{ab} = 0$; $\lambda_{bc} = 1$; $\lambda_{ca} = -1$.

$$K^0 = [3(3+0)+1]+\frac{1}{30}arctg\left[\frac{0{,}86(1+1)}{0+0{,}5(1-1)}\right] = 9.$$

Conclusions

There has been identified two solutions destined to improve the graphic- analytical variant of the continuous current method and they are confirmed in all the 12 cases related to the possible hour indexes.

Of the two solutions, one is applicable in the case of the initial codes panel, ant the other is applicable in the case of the rationalized codes panel.

The greatest importance belongs to the first formula that may be applied in the case of the initial codes panel, which has a broader usage and fame among practicians.

Though the two formulae seem intricate, their usage is relatively simple, as the coefficients q, t, λ_{ab}, λ_{bc}, λ_{ca}, may only have the values: "0", "1", "-1".

References

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