2.4. Conclusions

The efficient numerical algorithm enabling solution of the above-mentioned optimization problems [1] has been worked out, realised and presented. This algorithm makes possible to determine the optimal voltages and currents at the load terminals, and so it allows to determine the network optimal working point (Fig. 1) according to the optimization problems formulated in Sections 2.2.3, 2.2.4 and 2.2.5.

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SYNTHESIS OF LINEAR, PARAMETRIC AND NONLINEAR COMPENSATORS FOR ELIMINATION OF DISTORTION AND LOSSES OF ACTIVE POWER

1. INTRODUCTION

Various structures of compensators can be obtained due to a network structure, the optimized quality coefficients, the assumed sets of constrains as well as the classes of systems used for compensator realization (SLS, parametric, nonlinear). The solutions of five optimization problems presented in the work [1] are the sets of the optimal active currents ${}_a\mathbf{i}^j = \{{}_a\mathbf{i}^j_\alpha\}$, of the system presented in the work (Fig. 1). These currents determine explicitly the distribution of the (optimal) voltages in all of the network nodes ${}_a\mathbf{u}^j = \{{}_a u^j_\alpha\}$, where α – number of the phase, j – number of the source or load.

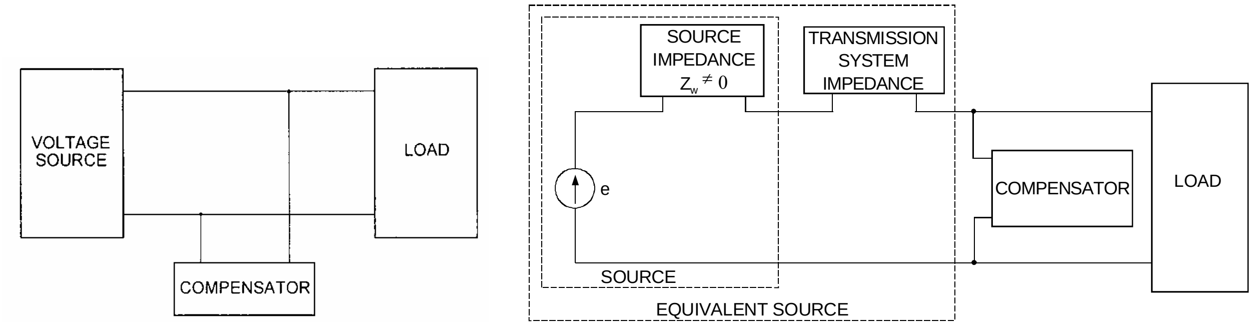
The optimal working points of the network from Fig.1 [1] are therefore determined by the set of the ordered pairs of the currents and voltages $\{{}_a\mathbf{i}^j, {}_a\mathbf{u}^j\}_{opt}$. These pairs are the basis for determining the necessary compensators which realize the optimal operating conditions in each of five mentioned cases [1]. To make synthesis of the compensators one uses difference currents which are difference between the primary currents and the determined optimal ones.

2. SYNTHESIS OF COMPENSATORS

2.1. Basic structures of the network

Problems dealing with synthesis of the compensators have been considered for two basic structures of the network:

– one-phase network, consisting of a sinusoidal or nonsinusoidal three-phase nonideal voltage source, a load and a compensator (Fig.1):



а   б

Fig. 1

– three-phase network consisting of a sinusoidal or nonsinusoidal three-phase voltage nonideal source, an appropriate load and a compensator (Fig. 2).

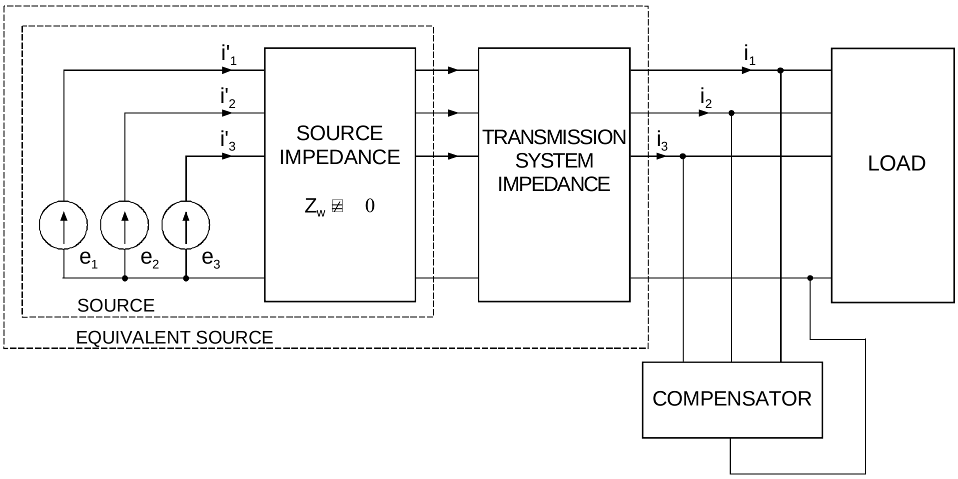


Fig. 2

For both of the assumed models (Fig. 1 and 2) the transmission system impedance has been included in the inner impedance of the equivalent source.

2.2. Methods of compensator synthesis

Investigations dealing with the choice of the compensator synthesis methods [7] and with the identification of the optimal working points of the system [2, 10, 13] have resulted in deciding on use of two methods, namely:

1. The optimization method consisting in minimization of the norm of the difference current (i.e. the difference between the primary current and the determined optimal current of the load) in relation to the compensator parameters,

2. The interpolation method consisting in solving the problems of the node interpolation by rational functions at the given values of voltage and current harmonics at the load terminals.

2.2.1. The problem of determining the optimal currents of the nonideal sources for one-phase systems is dealt with in the previous works of the authors. This problem is also considered in the papers [9, 11, 14] for three-phase systems with impedances in from SLS multipoles. The problem of identification of the optimal working point in case of modelling one-phase source impedance by an parametric one port has been presented in the papers [3] and [12], whereas this problems generalized for three-phase systems has been discussed in the paper [14].

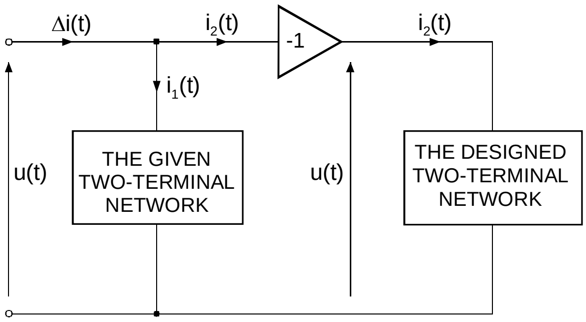


Fig. 3. Model of the performed optimization

The methods of optimization synthesis of SLS two-terminal networks, parametric and nonlinear ones, are described in the works [2, 3, 5]. The characteristic of the optimization synthesis is that it enables to determine directly the stationary lumped elements R, L, C, M, the parametric elements R(t), L(t), M(t), C(t), as well as the nonlinear resistances, inductances and capacitances which are the elements of the designed two-terminal network structure. These methods consist in minimization of the norm of the difference current which is the difference between the current of the given two-terminal network and the current of the designed two-terminal network of the given structure (Fig. 3).

2.2.2. The methods of the compensator choice as well as the algorithms of their synthesis made by interpolation procedures are presented in the works [11, 13, 19]. The paper [11] describes the method of choosing the suboptimal compensators realized in the class of LC one-ports. The method of the LC compensator synthesis for a three-phase system is presented in this paper (Fig. 2). It is characteristic for this method that the designed compensator is obtained as a result of minimization of the norm of the difference between the active system optimal current and the suboptimal current generated by the LC compensator. The compensator designed in this way is an optimal compensator of a three-phase system in the class of LC systems [10]. The work [9] deals with method of compensator synthesis and the computer algorithms for an n-phase system which is the equivalent of the system shown in Fig.2. One should point out that the method of synthesis described in the work [9] makes possible symmetrization of n-phase systems. The paper [16] is a supplement to the papers [9] and [1]. The method of the LC compensator synthesis ensuring maximization of the power coefficient in the system (Fig.3) is described in this paper.

2.3. Results

Investigation made by the authors dealing with the synthesis of compensators have been multidirectional ones. Apart from the problems discussed above the results have also been obtained in the field of active compensator synthesis as well as the structures containing switches and stationary elements or switches and active elements. The efficient algorithms of the compensator synthesis in different classes of elements have been worked out [13, 15].

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