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Rozprawa doktorska

Redukcja zniekształceń napięcia wyjściowego  
falowników napięcia przeznaczonych do systemów UPS  
dla normatywnych obciążeń

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Abstract of the PhD thesis „Reduction of the output voltage distortion of the voltage source inverters designated for the UPS systems for the normative loads”

Voltage source inverters are one of the basic components of the uninterruptible power systems UPS. The typical loads types of the inverter are the resistive load (static or dynamic) and nonlinear  $RC$  rectified load. The quality of the output voltage given by the VSI is standardized in according to the European and global standards: PN EN 62040:3, IEEE 519. The topology of the inverter, the quantity of the phases, the loads types and the application of the DC/AC inverters pose many challenges in according to the quality of the output voltage of the inverters, fulfillment of the standards and improvement of the efficiency concerning the whole system.

In the thesis there are few innovative methods of the control for the single phase and three phase inverters based on the model with the full H bridge. Only the total overview based on the model, used controller of the MISO (Multiple-Input Single-Output) type could maintain output voltage quality recommended by standards. The input variables of the control are the output voltage, the inductor current and the load current. In the thesis it was demonstrated that MISO control type behaves more efficient in comparison to SISO (Single-Input Single-Output) type in reference to the feedback control included also predictive control types. It was proposed two new methods of control based on the methodology – MPC (Model Predictive Control) and PBC (Passivity Based Control). During the implementation process it was taking into account the reduction of the distortions of the output voltage with the fast acting on the parameter changes (ranking the overshoot amplitude and the settling time). The process of the reduction of the output voltage was preceded by the proper selection of the output  $L_F C_F$  filter. It takes care about the distortion in the upper frequencies, upper than cut of frequency of the output filter that is below  $f_c/2$ , where  $f_c$  is the switching frequency.

Using the principles of the energy flow and balance the advanced inverter control for the inverter working with the impedance network and battery loading in the non-shoot through time was proposed. Apart from this method also the maximum power point was achieved using for this PV simulator and qZ-Source.

As a part of work it was also proposed additional coefficient of the output quality based on the time-frequency analysis. This coefficient was treated as an additional, complementary coefficient that define the output voltage quality similar to percentage of the output voltage distortion  $THD_v$ , settling time and amplitude of the overshoot pointed by the standards. The advantage of such a solution is the versatility and independence of the load type, which improve a lot the design procedure of the VSI. Using the continuous wavelet transform CWT based on the Morse wavelet we are able to localize also the biggest distortions of the voltage signal in time.