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The changes of Inductors' inductances and resistances with frequency in Inductive Pulse Power Supply

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In an Inductive Pulse Power Supply (IPPS), when the inductors are charged and discharged, they face different capacitive loads, i.e. the frequencies of charging and discharging are different. According to our experiences, inductors' inductances and resistances may change with frequencies. If constant inductance and resistance for one inductor are used in simulation, errors may occur. So it is important to study the change rules of inductors' inductances and resistances with frequency in IPPS. However, it is hard to directly measure the inductances and resistances because the oscillation frequencies are very low in high energy level IPPS and are out of the measuring ranges of most instruments. This paper uses experiment method to solve this problem. First, we use different capacitors with pre-charged voltages to construct under-damped second-order circuits with one inductor. The changing voltages of the capacitors can be measured accurately. With known capacitances, the inductance and resistance of the inductor can be obtained by fitting the voltages values with the under-damped oscillations. This paper uses 7 capacitors to do the experiments with 3 inductors respectively, and thus obtains 21 inductances and 21 resistances through the above fitting method. Using these numbers, we can further fit out the curves of inductances and resistances changing along with frequencies. The curves show that the inductances change slightly and the resistances change dramatically along with the frequencies in the range of 5-300Hz. After normalization, these curves may have more extensive applications especially when using inductors in low frequencies.

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