別紙様式３

学位論文の要旨

フリガナ 氏　　名	エコ　セティアワン EKO SETIAWAN
専　　攻 入学年度	宮崎大学大学院農学工学総合研究科博士後期課程 物質・情報工学専攻 （西暦）2015　年度（10 月）入学
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【論文の要旨】

The power converter is one of the fundamental parts of any electronics system. The power converter provides a required voltage or current of the system. Failure on the design and control of power converter affects the main system defective. In order to design a power converter with specification, we should use a model that represents the system mathematically. A power converter has two modes which are called a continuous conduction mode (CCM) and a discontinuous conduction mode (DCM). Most researches design the system based on CCM but they never guaranteed that their system will stay on CCM. If the system goes to DCM but if the system is designed in CCM, then the converter may lapse into behavior out of specification.

In Chapter 2, this study proposes to use a symbolic steady state model of buck converter. Since the steady state response is a periodic signal with a period of switching, it may has a Fourier series representation. It is easy to calculate the Fourier series if we are given a numerically represented signal. However, it does not give a clear relationship between constants in the circuit elements and constants in the behavior such as an average and a ripple of voltages and currents. Our method will decompose the steady state signal of buck converter into a sum of several periodic functions called recovery functions. This process is done with a symbolic calculation, and enables to know how a constant in the circuit elements affects a constant such as a ripple. This would give a clear design step of buck converter.

In Chapter 3, this study proposes a nonlinear control of boost converter that forces the behavior inside CCM region. The idea of design step is to use a phase portrait of behavior. Since the controller is given with geometrically understood way, it could describe an initial condition and a reference condition on the portrait. Our proposed controller is shown to bring the voltage and current to a reference point without going into DCM region. The simulation and experiment results show that the proposed controller successfully keeps the boost converter on CCM in any initial condition.

In Chapter 4, this study summarizes a control problem in power converter and describes how the proposed ideas are used to the problem. Then it is pointed out that their ideas may be applied to some problems in power conversion for the future works.