



Soutenance de thèse

Lundi 3 avril
14h00 – Amphithéâtre

Monolithic Isolate Interface for Bidirectional MOSFET Switches dedicated to the Control of Tuning and Energy Conversion Systems Used in Medical Applications directed

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Abstract :

This thesis extends previous studies on the prospects of HIFU for the treatment of cancer. An array of ultrasonic transducers generates a beam of ultrasound to eradicate malignant cells. MRI systems lead HIFU systems to provide high resolution imaging. For optimum energy transmission, the ultrasonic transducers have an automatic synchronous adjustment system. An isolated transmission system (AC switch driver) is required to drive an AC switch to control the automatic synchronous adjustment system.

The objective of this thesis is therefore to design an isolated AC switch driver circuit which must be immune to the magnetic field, attenuate common-mode voltage, be energy efficient, miniaturized, have negligible signal delay, and comply with IC requirements.

A CMOS-based system is proposed to attenuate the unwanted common-mode voltage. A novel single-ended design capacitive transmission system is designed to attenuate the common-mode voltage by adding a high-pass filter. Based on the high-pass filter, three innovative isolated AC switch drivers were proposed and designed using 0.35 μ m CMOS technology with single-ended and differential structures. Among the single-ended structures, a first-order high-pass filter based system can cope with a common-mode voltage of up to 40 V with an immunity as high as 120 V/ μ s. While the second order HPF-based system attenuates a common-mode voltage of 120 V with an immunity of up to 720 V/ μ s. The signal transmission delay and power consumption for first- and second-order systems are less than 10 ns, 2.66 mW and 12 ns, 1.38 mW, respectively. A third AC switch drivers based on a differential structure has also been proposed, which is more immune to noise and has a high signal-to-noise ratio. The differential system attenuates a common mode voltage of 90V with an immunity of up to 540V/ μ s. The overall system consumes 5 mW with an output signal delay of 12 ns. For experimental verification, the single ended systems are tested on the printed circuit board.

Keywords : Isolated transmission system, floating ground, capacitive isolation, CMOS, AC switch, HIFU system,

