Can you describe the projects that you work on in collaboration with Bosch and Siemens Home Appliances Group?

The Group of Power Electronics and Microelectronics (GEPM) of the University of Zaragoza and the Bosch and Siemens Home Appliances Group (BSH) have established a long-term collaboration agreement to research and develop domestic induction heating technology. These appliances have significantly evolved and nowadays they require a multidisciplinary approach to optimise them. The GEPM focuses on three different areas of development, including power electronics, digital control and inductor design. Most of the efforts are aimed at improving the performance and efficiency of these appliances.

How are induction heating systems evolving?

Since the first induction heating appliance appeared on the market in the 80s, this technology has evolved to offer improved performance, higher output power, finer control and improved efficiency, while keeping it as a cost-effective solution.

However, nowadays classical architectures with fixed cooking areas are becoming obsolete and are being replaced by flexible cooking surfaces, such as the one shown in our Letter. This technology allows the user to use any number of pots, with any shape and anywhere. This implies a technology breakthrough since the complete system needs to be redesigned and optimised.

What challenges does this present?

The main challenges when designing a total active surface appliance are the design of small ring-type inductors, and the design of a multiple-output power converter featuring high efficiency and proper power control with a high load variability. Since an induction heating appliance has reduced ventilation capability and operates with high ambient temperature, efficiency is a must to avoid heat generation.

What you have achieved in your Electronics Letters paper?

Our Letter deals with one of the main challenges when designing a multiple-output resonant power converter: the optimisation of efficiency over the whole range of operating conditions. The resonant converter operation highly depends on the load and, unlike classical appliances, flexible cooking surfaces lead to a highly variable load.

The Letter therefore proposes a procedure to optimise converter efficiency over the whole operating range. Snubber networks are usually used in power converters to reduce the switching losses and, as a consequence, improve the overall converter efficiency. Our solution is based on a variable snubber network that adapts the capacitor value to the operating conditions in order to maximise efficiency. As a consequence, the converter can operate over the wide operating conditions range required by the application with a cost-effective implementation.

Where will this be useful?

The proposed configurable snubber network can be applied to any power converter that requires operation with high load variations. In particular, it is highly recommended for the new total active surface appliances to improve their efficiency and, consequently, reliability and performance.

How will you be developing this work further?

The development proposed in our Letter is one of the first steps to design a reliable multiple-output resonant power converter. The next steps include the optimisation of the converter topology and the output power control. The final power converter implementation should be able to provide accurate power control for each one of the induction loads. For instance, nowadays a power converter supplies a single induction load. However, new architectures require a single multi-output power converter to control up to 12 induction loads.

How would you like to see this field progressing over the next few years?

Advances in power electronics, digital control and inductor design should lead to a reliable and affordable implementation of a total active surface appliance. In that time, this technology will replace the current fixed-cooking-area technology that has been with us for many years, and it will bring the user a completely new cooking experience: high efficiency and high performance, with improved flexibility.