

Improving the performance of electric induction motors

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The School of Engineers in Eibar (UPV/EHU-University of the Basque Country) was where Patxi Alkorta, a local professor, defended his thesis, following his research into advanced motor control devices. These control devices are units designed to correct errors and improve the performance of the motors. This researcher has opted for cutting-edge models and has developed them so that they can be applied to an induction motor, and in this way he has transferred them from theory to practice. To do this, he made use of an experimental platform located at the school in Eibar. "These control devices have been used before, but I have adapted them for use in an induction motor, and I have shown that they are in fact applicable and suitable," says Alkorta. His thesis is entitled *Desarrollo e implementación de controladores avanzados para motores eléctricos* (Development and implementation of advanced control devices for electric motors).

The asynchronous (or induction) three-phase is the type of motor most widely used in industry. "Most of the electrical power consumed worldwide is in fact used by asynchronous motors," explains Alkorta. So it is essential to optimize the way they operate so that, among other things, they consume the lowest amount of energy possible and savings are made in power costs. Control devices are a great help in this task.

Speed and position

Alkorta has focussed on advanced control devices that specifically help

to adjust speed and position. Firstly, as each motor has been produced to operate at a specific speed, there have to be guarantees that this will be maintained, irrespective of any alterations (oxidation, friction, etc.) that can be caused by time. Secondly, it is a similar story with regard to position. For example, if a motor is required to turn 30 degrees, apparently it should not be too much to require that it should remain firm in the new position once it has made the turn, but in practice there are pitfalls; like for instance the load on the axis. As Alkorta explains, "the task of the control device is to mitigate the impact of that load. The better the control device is, the less that load impact will be noticed."

To correct the problems of speed and position, this researcher has developed and validated several advanced control devices on the basis of the proposals of a number of authors and by making adaptations in order to apply them to induction motors. "I have adjusted them and I have come up with three versions in each case, including some changes. I have done some experimenting and I have seen that they are in fact valid," he points out.

Specifically, he has worked with two types of advanced control devices: Sliding Mode Variable Structure Control Devices, and Generalized Predictive Control Devices. With those of the first type it is possible to mitigate those changes that the motor undergoes as a result of time, and which are unpredictable (inertia, friction, etc.); and with those of the second type, the performance changes that need to be demanded of the motor in the future are determined in advance. In other words, the control device of the first type enables us to know, for example, that the motor will require more revolutions in the future to maintain the same degree of operation; and in the second type the machine can be gradually prepared in advance to make these adaptations.

At the same time, Alkorta has experimentally validated the versions developed on the basis of these models, which has constituted the main

contribution of his thesis. For this work, he used the experimental platform at the School of Engineers in Eibar. It goes by the name of Ei-IM-1 and is based on a 7.5 kW commercial induction [motor](#). It was in fact started by Alkorta and some of his colleagues four or five years ago so that tests of this type could be carried out. It has enabled this researcher to verify that these advanced control devices developed to monitor speed and position can be used in real industrial applications.

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