

## The linear motors: Close examination

Linear motors are considered something extremely new, a new frontier in the systems of linear positioning today. The word "linear motors" indicates a motorization with a direct transmission mode for the load to move: linear motors for line travels and motor couple (or torque motors) for rotary movements. Traditional rotary motors require the integration of a reduction gear and a special mechanical system in order to transform a motion from rotary to linear, for instance a toothed bent or a rack are usually needed in this case. This makes this system complicated, it requires a lot of space, but above all, some mechanical backlash are inevitable, that exclude very accurate positioning, in addition to that, speed and accelerations are limited. A linear motor is conceptually similar to a rotary motor but linearly developed: a line of magnets, installed parallel to each other, and a movable winding where usually the mass to move, is fixed. In order to exploit such system a mechanical guide way is needed, that bears the load and moves it with accuracy on-line straight line, obviously, through a special drive unit.



LINEAR MOTORS OFFER EXTREMELY HIGH SPEED AND VERY HIGH ACCELERATIONS, ACCURACY IN POSITIONING, AND FULL OPERATIONAL RELIABILITY EVEN AT LOW SPEED. IN ADDITION THEY OFFER COMPACTNESS, EASY HANDLING, AND AN EXTREMELY LIMITED MAINTENANCE; MACHINES EQUIPPED WITH LINEAR MOTORS ARE LESS NOISY.



The main movements to be performed in a milling machine are **Linear Movements**. Linear motors are electrical motors that can develop a motion in this form without having mechanical cinematic for movement transformation. The reduction or even the elimination of kinematics components allow, in fact, to guarantee repeatability and accuracy of positioning, that could not be achieved with traditional methods. This ne system allow increased performances with a total operational flexibility and eliminating completely wear. Extremely good levels of reliability and of excellent constant performances are achieved. These motors are specially remarkable through their capacity of complying with severe laws of motion with high accelerations and high speed, this makes them unique in applications with high speed dynamics. Conceptually linear motors are made through unrolling a synchronous motor with permanent magnets on a plan, a cursor is created from motor windings that run on a bed of magnets. The forces created by the sinusoidal current applied to the motor windings produce now a movement along the axis instead of a couple.

## Application of linear motors on CNC milling machines

Position and speed are detected by a single measuring system, a high resolution optical scale, that allows to read/determine the absolute axis position. In order to have an accurate adjustment of speed presence even in case of slow movements, we need not only a high resolution of measuring system, but also a correct and accurate interpolation of signals. Finally numerical control and axes drives must be designed in a suitable way in order to be able to manage correctly such motors allowing highest performances.

## why are linear motors not so common today?

In spite of various advantages, direct transmission linear motors and motor couple are not very much spread out and the main reason is the lack of knowledge concerning its real potentiality and performances. And it has to point out that many machine tool manufacturers, having neither knowledge nor suitable technology for its application, are inclined to express a negative opinion about linear motors, emphasizing and exaggerating the problems encountered during the first applications (for a long time already solved, for instance the excessive size of the cooling systems for cooling motors and the too high electric energy consumption). Nowadays machine tools with identical configuration, but with different motorization with or without linear motors/torque motors, have more or less the same electricity consumption with similar performances. Clearly prices are still too high due to the costs of installed materials, for instance the permanent magnets using very expensive rare earths and their production process. PARPAS group installs linear motors on machines mod. DIAMOND ESAGON, Extrema, EMERALD, HS and HSC, in the remaining machine models only torque motors are installed for head swivels or CN rotary tables.