Measuring DC motor position without an encoder?

This thesis explores using voltage and current ripples caused during commutation in brushed DC motors for velocity and position estimation, potentially reducing the need for expensive encoders by combining ripple detection with lower-resolution encoders.

Is it possible to avoid having to utilize expensive encoders for velocity and position estimation related to brushed DC motors? This is the question the authors of this thesis asked themselves when they set out to explore possible alternatives. It turns out that the voltage and current across a brushed DC motors are subject to small, repeating, pulsation or “ripples” that occur during the commutation process. This is caused by the fact that the brushes can make contact with either one or two commutator segments at the same time, depending upon whether the brushes are transitioning between two commutator segments or not. Because of this the impedance(also induced voltage) changes slightly in a periodical manner that is proportional to the velocity of the motor.

The main problem in using this phenomenon for measuring position and velocity lies in the ability to see them. As such, the authors explored a solution involving analogue filters, amplifiers and microcontrollers in order to find the ripples on a sliding door system, a common application of brushed DC motors. The results were promising at lower to medium velocities, but it was realized that the main problem standing in the way of better results at higher velocities was the limited sampling frequency of the microcontrollers. However, the results still indicate that current or voltage ripples likely can yield adequate velocity measurements. Even though the technique might not completely replace encoders, it might enable companies to use encoders of lower resolution via a combined ripple and encoder approach.Even if speed and position tracking is feasible at low and medium speeds, it is quite more challenging during acceleration and deceleration.