



VIII. Conclusions

Observe the motor's fast torque response to the torque set point changes. From 0.02 s to 0.25 s, the fan speed increases because of the 600 N.m acceleration torque produced by the induction motor. At $t = 0.25$ s, the electromagnetic torque jumps down to 0 N.m and the speed decreases because of the load torque opposed by the fan. At $t = 0.5$ s, the motor torque develops a -600 N.m torque and allows braking of the fan. During braking mode, power is sent back to the DC bus and the bus voltage increases. As planned, the braking chopper limits the DC bus voltage to 700 V. At $t = 0.75$ s, the electromagnetic torque jumps back to 400 N.m and the speed settles around 100 rpm and increases toward 0 rpm. Note that the flux stays around 0.8 Wb throughout the simulation. The flux and torque oscillation amplitudes are slightly higher than 0.02 and 10 N.m respectively as specified in the user interface. This is due to the combined effects of the 15 μ s DTC controller sampling time, the hysteresis control, and the switching frequency limitation.

The following figure shows the simulation results of the XY scope. The rotating field is clearly visible. Its modulus is about 0.8 and its bandwidth is slightly bigger than 0.2.

For any IM drives, Direct torque control is one of the cheapest and simple controllers. It allows independent control of motor stator flux and electromagnetic torque. From the analysis it is proved that this strategy of IM control is simpler to implement than other vector control methods as it does not require pulse width modulator and co-ordinate transformations, but it introduces undesired torque and current ripple. DTC scheme uses stationary d-q reference frame with d-axis aligned with the stator axis. Stator voltage space vector defined in this reference frame control the torque and flux. The main inferences from this work are: 1. In transient state, by selecting the fastest accelerating voltage vector which produces maximum slip frequency, highest torque response can be obtained. 2. In steady state, the torque can be maintained constant with small switching frequency by the torque hysteresis comparator by selecting the accelerating vector and the zero voltage vector alternately. 3. In order to get the optimum efficiency in steady state and the highest torque response in transient state at the same time, the flux level can be automatically adjusted. 4. If the switching frequency is extremely low, the control circuit makes some drift which can be compensated easily to minimize the machine parameter variation. The estimation accuracy of stator flux is very much essential which mostly depends on stator resistance because an error in stator flux estimation will affect the behavior of both torque and flux control loops torque and current ripple can be minimized by employing space vector modulation technique.

IX. REFERENCES

[1] Thesis NIT Rourkela Page 43