

Harmonic correction CD UCB1/2

Purpose

Effective for reducing errors/ripples caused by fixed pattern cyclic errors induced either as feedback error or as torque disturbance.

Mechanism

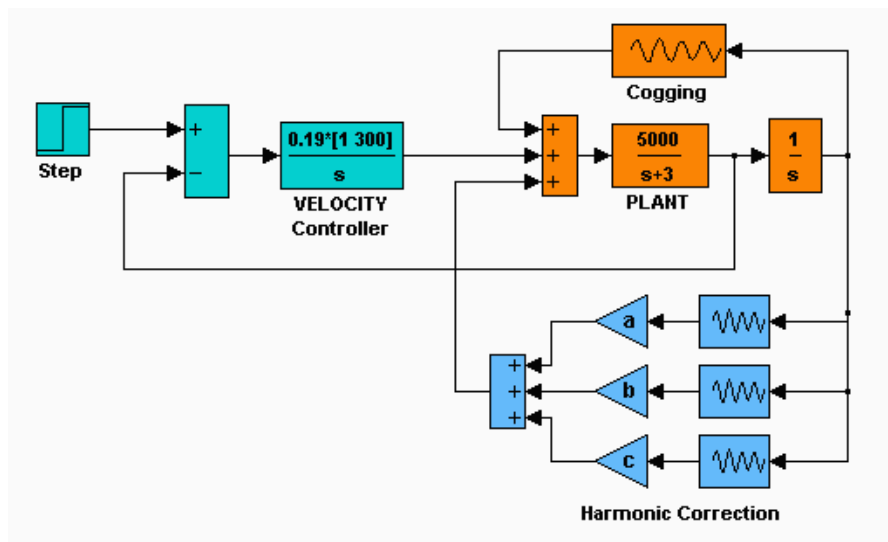
There are 3 harmonic components HC1,HC2,HC3 each defined by:

- Harmonic number (how many cycles per motor rev / pitch).
- Phase – alignment relative to motor position.
- Amplitude.

A separate variable HCMODE specifies different combinations of using the harmonics for feedback or torque correction.

Feedback correction harmonics are added to position before derivation to velocity, in the velocity feedback path (position feedback used for position control is not corrected).

Torque correction harmonics are added to the torque command (ICMD) generated by velocity control, and fed to the current control.



The above simulative diagram demonstrates signal flow for torque compensation with 3 harmonics. The physical cogging is modelled as a position dependent torque disturbance.

Syntax

HC1 xx yy zz

HC2 ...

HC3 ...

Harmonic correction

xx – Harmonic number : 1,2,... cycles per rev/pitch

yy – Alignment offset 0–360 deg

zz – amplitude

Torque correction [current counts] out of 32767/dipeak

Feedback correction [PRD position counts] out of 65536/rev

HCMODE	Feedback	Torque
0	–	–
1	HC1	HC2, HC3
2	–	HC1, HC2, HC3
3	HC1, HC2, HC3	–
4	HC1, HC2	HC3

Note: Using a harmony with amplitude of zero nulls its effect.

Applicability

Feedback harmonic correction takes effect only for resolver systems.

Harmonic correction is expected to reduce 60–90% of the cyclic disturbance.

Harmonic correction will only work for velocity and position operation modes.

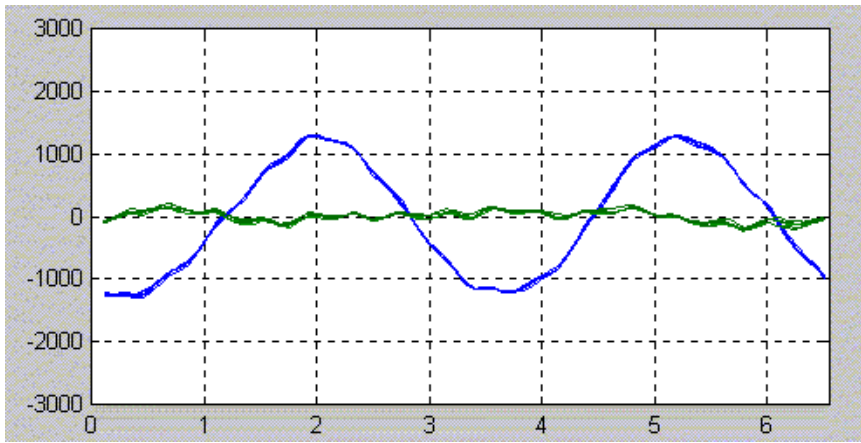
Note: At specific operating conditions either feedback or torque corrections may provide similar solution to the ripple, however if the source of the error is confused, the correction will fail as the operation conditions (speed) change, cases of combined errors of torque and feedback at the same frequency are more difficult to tune.

Tuning

Manual tuning of the harmonic parameters is possible. Using the DAC output for monitoring on a scope, the variables which can be used are current command (ICMD), velocity (V), and the output of the velocity controller without the torque injections (ANOUT=10).

Automatic feedback correction tuning is available on a custom UCB2 firmware 6.3.3i. with this firmware, resolvers can be calibrated during constant speed jog. An AUTOHC command is used for optimizing specified harmonics automatically. For more information on this possibility please advise.

Harmonic correction



The above shows the current ripple of a motor over one revolution before and after applying the harmonic correction. The x-axis covers 1 motor revolution.