A Nonstandard Approach to Use of RC to Allow More Dense Storage in Computer Disk Drives
Position error during the track writing process results in imperfect circular tracks, due to external vibration, variation in mechanical geometry, track writer positing error, etc.

Written-in position error is implicitly sampled at each servo sector.

Frequency spectrum of written-in position error will consist of discrete frequencies that are integer multiples of the spindle frequency.
RRO, NRRO, and PES

- PES (Position Error Signal) contains
  - Repeatable Runout (RRO)
  - Non-Repeatable Runout (NRRO)
- The statistical $3\cdot\sigma$ values of RRO, NRRO, and PES are used as performance indexes

$$\sigma_{PES}^2 = \sigma_{RRO}^2 + \sigma_{NRRO}^2$$

- Objective of repetitive controller is to follow a perfect circle of radius equal to the average radius of the track.
- Allows using tighter track density, allowing more data to be stored on
Structure of New Repetitive Controller for Canceling Measurement Disturbances

\[
S(z) = \frac{1}{1 + K(z)P(z)}
\]

Inside \(L(z)\):

\[
P(z) = z^{-g}M(z)Q(z) + e(k)
\]
Conclusions

- A non-standard type of repetitive control is developed for canceling periodic measurement disturbances.
- Repetitive control law reduces the repeatable runout (RRO) by 98% within 15 revolutions.
- This corresponds to a 36% reduction in the $3\sigma$ value of position error signal (PES).