Web Guiding In Vacuum

Aravind Seshadri
Roll-2-Roll Technologies LLC
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Why do we need to guide?

➔ Lateral shift at unwind
   Non-centered core

➔ Imperfect unwind roll
   With lateral misalignments

➔ Imperfect web
   Web gauge variations, camber or bagginess

➔ Imperfect machine
   Misaligned rollers, out-of-round rollers

➔ Imperfect process
   Air/fluid interaction, coating gauge variations, traction issues
A typical automatic web guide control system includes a **Guide Mechanism**, **Web Position Sensor**, and **Controller**.
What’s different in vacuum?

Environment
- No air/gas
- Heat dissipation
- Outgassing

Space Limitations
- Space is expensive
- Span length constraints
- Minimum number of rollers
Environment

Space devoid of gas/air can affect web position sensors.

→ **Pneumatic sensor**
  By definition need air flow and hence not suitable for vacuum.

→ **Ultrasonic sensor**
  Need air for sound propagation and hence not suitable for vacuum.

→ **Infrared sensor**
  Will work in vacuum but only with non-transparent material.
Environment

*Space devoid of gas/ air* also adds constraints such as

- **Heat dissipation**
  Heat generation from sensor and actuator should be low.

- **Outgassing**
  Sensor and actuators should not outgas.
Ideal sensor technology should provide reliable measurement, should not create excessive heat and not outgas.

Camera Based
A camera based system could potentially work, however they are expensive, bulky and may generate heat.
Space Limitation

The second biggest constraint is space:

➔ Span lengths
   Are typically short

➔ Choice of Web Guide
   Is limited because of the space constraint
Appropriate choice of Web Guide Mechanism should not take up a lot of space while providing the required correction.
How to pick the right web guide for your application?
Types of Web Guides

Intermediate guides

Terminal guides
Displacement Guide or Offset-pivot Guide

The work horse

Best intermediate guide with good dynamic performance.

Minimal stress and bending of the web.

Simple, stable, relative degree zero system
Displacement Guide or Offset-pivot Guide

Disadvantages

- **Bulky**
  For wide web applications

- **Excessive heat generation**
  For wide web applications

- **Web wrap**
  Two 90 degree wrap may not be ideal

Issues in Vacuum
Steering Guide or Remotely Pivoted Guide

Simple yet complicated

Simple mechanism

Significant correction possible

Good dynamics response

Simple, stable, relative degree zero system
Disadvantages

➔ Long span
  For entry (3 to 5 times width) required for effective correction

➔ Wrinkles
  Can be generated with very short entry span

➔ Significant stress
  Could be induced in the web due to bending

➔ Complicated
  Installation with a lot of attention to span length requirement
End Pivoted and Center Pivoted Guide

Rarely used

Simple mechanism

Requires long spans

Complicated, relative degree two system

Slow response with stability issues
End Pivoted and Center Pivoted Guide

Issues in Vacuum

Disadvantages

➔ Long span
  For wide web applications

➔ Wrinkles
  Can be generated with very short entry span

➔ Significant stress
  Could be induced in the web due to bending

➔ Complicated
  System with the integral action requires complex control system
Shifting Roller

Not a web guide

Simple mechanism

May provide immediate correction

But at steady state web goes back to original position

Relative degree two system
Correcting roll offset

Sensor fixed to machine

First roller moves with the unwind stand

Simple, stable, relative degree zero system
Rewind Sidelay

Not a web guide

Simple mechanism

May provide immediate correction

But at steady state web goes back to original position
Best Choice

➔ **Unwind Guide**
Best option for most wide web applications

➔ **Intermediate Guide**
End/ Center pivoted may be an option for narrow webs

➔ **Rewind Guide**
Only with process induced disturbance

➔ **Displacement Guide**
Best choice with a lot of process induced disturbance and if wrap is not an issue.

Avoid Using

➔ **Remotely Pivoted Guide**
Complicated to get it right

➔ **Shifting Roller**
Not a guide, does not work
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