Battery Manufacturing

Industry Application

Overview

Roll-2-Roll Technologies provides advanced sensor solutions designed for the spatial constraints and precision requirements of modern battery manufacturing. As the industry moves toward wider webs and faster line speeds to reduce cell costs, precision becomes critical. Our **one-sided, integrated sensor design** combines light source, optics, and camera into a single compact unit—eliminating the need for bulky external gantries while delivering **0.016 mm firmware resolution**. **No programming is needed**—operators can set up the system in minutes, reducing engineering overhead and total cost of ownership.

The Engineering Challenge

Battery manufacturing lines involve harsh environments and extreme precision requirements that defeat traditional sensing methods.

- **Spatial Constraints:** Critical measurement points inside drying ovens or immediately before calender presses are notoriously tight. Traditional C-frame sensors simply do not fit.
- **Electrode Misalignment:** Anode and cathode coatings must overlap with extreme precision. Drifting by even a fraction of a millimeter can cause lithium plating or short circuits.
- **"Lost Edge" Stops:** Heavy battery foils wander during splices or speed ramps. Narrow-view sensors lose the edge, triggering costly machine E-stops.
- **Calendering Damage:** If the web enters the high-pressure calender nip slightly skewed, wrinkles are pressed into the electrode, destroying the material.

The Roll-2-Roll Technical Advantage

We address these challenges with a unique architectural approach that prioritizes accessibility and performance. Effectively, you get a **Vision System in a Sensor Package**.

- **Line Scan Camera Technology:** While marketed as a sensor, the device functions as a one-dimensional line scan camera with a pixel array ranging from 768 to over 14,000 pixels. This provides the "spatial awareness" to see multiple edges and features simultaneously.
- **Linear Optical Technology:** Unlike traditional cameras with circular lenses that cause distortion, our patented fiber-optic array provides 1:1 image magnification. This ensures measurement resolution is

identical across the entire field of view.

- **Compact, One-Sided Installation:** Our sensors operate from a single side of the web, allowing installation in restricted areas (working distance 15-25 mm standard, up to 50-100 mm on special order) where traditional frames won't fit.
- **Wide Viewing Area:** We offer a significantly wider viewing area (up to 960mm) compared to standard sensors, ensuring continuous tracking even when the web wanders significantly during process upsets.
- **Sub-Pixel Precision:** Sub-pixel interpolation gives a firmware resolution of 0.016 mm, critical for holding tight coating tolerances.

Key Applications

1. Electrode Coating Alignment & Width Measurement

Ensure precise overlay of anode/cathode coating on current collectors. The **wide viewing area** allows for real-time monitoring of both the coating edge position and the total coating width. The sensors use **contrast detection** to measure the distance between the edge of the metal foil and the edge of the active material coating, ensuring the coating is properly centered and applied.

2. Calender Infeed Guiding

Space is at a premium near high-pressure calender rolls. Our **compact, one-sided sensors** can be mounted immediately adjacent to the nip point. This proximity reduces "dead time" (transport lag), providing the web guide with real-time data to correct high-frequency disturbances before wrinkles occur.

3. Trim and Tab Measurement

The system can simultaneously measure multiple specific widths, such as "trim one width," "trim two coating width," and "tab width." In the slitting and notching phase, accurately measuring these dimensions is critical for quality control. Roll-2-Roll's high-resolution sensors provide the precision needed to verify tab tolerances in real-time.

4. Electrode Slitting

Repeatable width measurement is used during the slitting of anode and cathode materials to ensure precise dimensions before cell assembly. With **0.016 mm firmware resolution**, operators can detect even minor width variations immediately, ensuring consistency across the entire roll.

Supported Web Guiding Solutions

Our controllers come pre-loaded with multiple guiding software modules, allowing one system to adapt to various battery production needs.

- **Center Guiding:** Uses two sensors to track both edges of the anode or cathode foil, keeping the centerline perfectly aligned during coating or calendering. Essential for maintaining symmetry on varying width foils.
- **Edge Guiding:** The most common application. Uses a single sensor to track the foil edge or coating edge for precise positioning entering the dryer or slitter.
- **Master-Slave Guiding:** Critical for lamination. One web (the master) is tracked, and the second web (the slave) is guided to align perfectly with it, ensuring repeatable anode-cathode overlap.

Digital Integration & Connectivity

Our controllers support major industrial protocols like **EtherNet/IP, PROFINET, and EtherCAT**, enabling seamless integration with battery line PLCs for automated control. The system also offers app-based data logging, allowing quality assurance teams to download width and position logs to CSV files for batch validation.

Technical Comparison

The "Scanner vs. Laser Pointer" Analogy: Comparing an Roll-2-Roll Sensor to a standard photo-eye is like comparing a flatbed scanner to a laser pointer. A laser pointer only tells you if something is blocking a specific spot (on/off). The sensor images the entire edge profile, and the controller identifies foil edge, coating edge or defect and its position.

- **Installation:** Traditional optical sensors require two-sided frames. Roll-2-Roll uses a **one-sided, compact mount** suitable for tight battery lines.
- **Sensing Window:** Standard sensors have a narrow window (10-20mm). Roll-2-Roll provides a **Wide Viewing Area** (up to 960mm) to prevent lost-edge stops.
- **Resolution:** Pixel-limited sensors struggle with microns. Roll-2-Roll achieves **0.016 mm firmware (sub-pixel) resolution**.
- **Components:** Instead of separate emitters and receivers, Roll-2-Roll offers an **All-in-One Integrated** unit with lower TCO.