

GobRadar – Closed Loop Control

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GMIC/GlassTrend Symposium

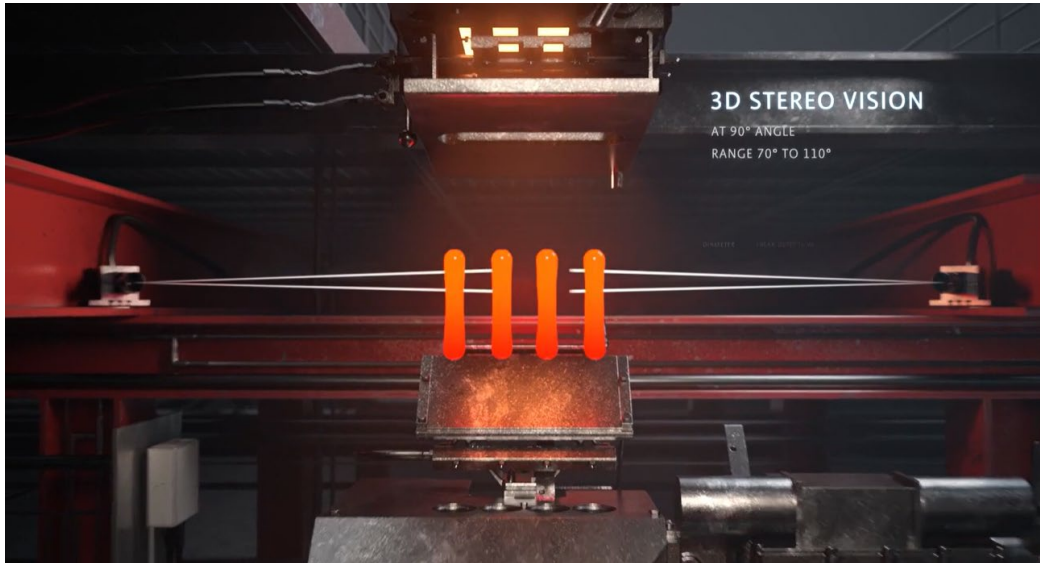
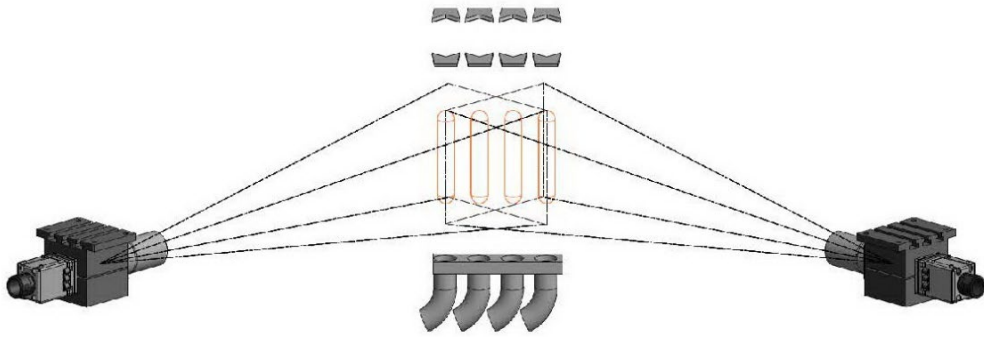
Sensor Technology in Glass Manufacturing

Tanner Kremer

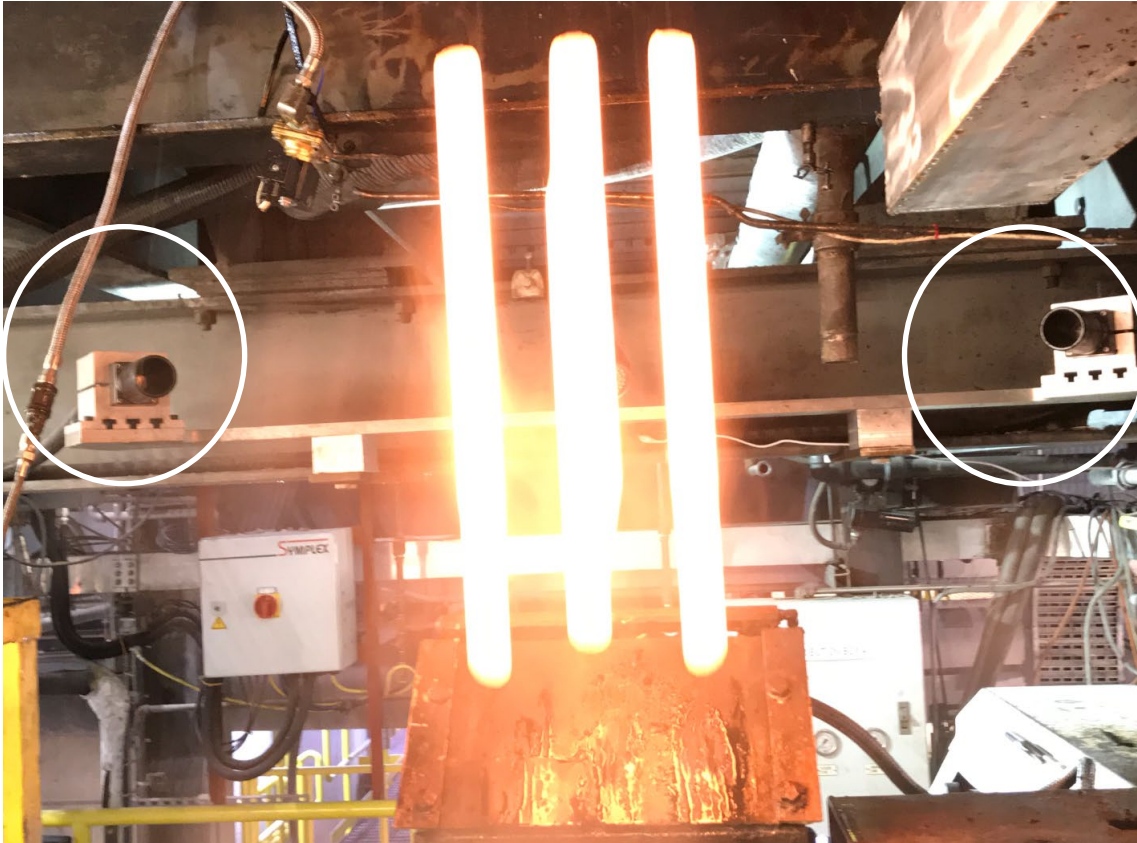


- 1. Description of system – how we use cameras as sensors**
- 2. Refresher of initial commercial launch – Weight and Length Control**
 - Weight and length control, including multi weight production– 2022
- 3. Recent development**
 - Tilt control – 2025
- 4. What's coming soon**
 - Shape control – coming in 2027

GobRadar – “Gob Cutting Observation”



- Didn't want to reinvent the wheel
 - Search and trial of gob cameras on mkt 2018
 - Selected Symplex – Gob Cutting Observation
- High speed matrix area scan cameras as the sensor
- Real 3D stereo setup (wide angle 90°)
- Monitoring “around the gob”
- Series of pictures taken after cut before scoop
 - Allows operation even if obstructed view
- Systems in use world-wide – approx. 60
 - Includes multi-weight production lines



TG Large Gobs

Real time data acquired:

- Weight / Mass
- Length
- Diameter
- Angle
- Position
- Trajectory
- Shape
- Temperature

**Traceability and quality assurance
from the moment the gobs are cut**

- **Dimensional Data**

- Length
- Diameter

2D Image



3D Model



- **Calculated Data**

- Weight/Mass
- Shape

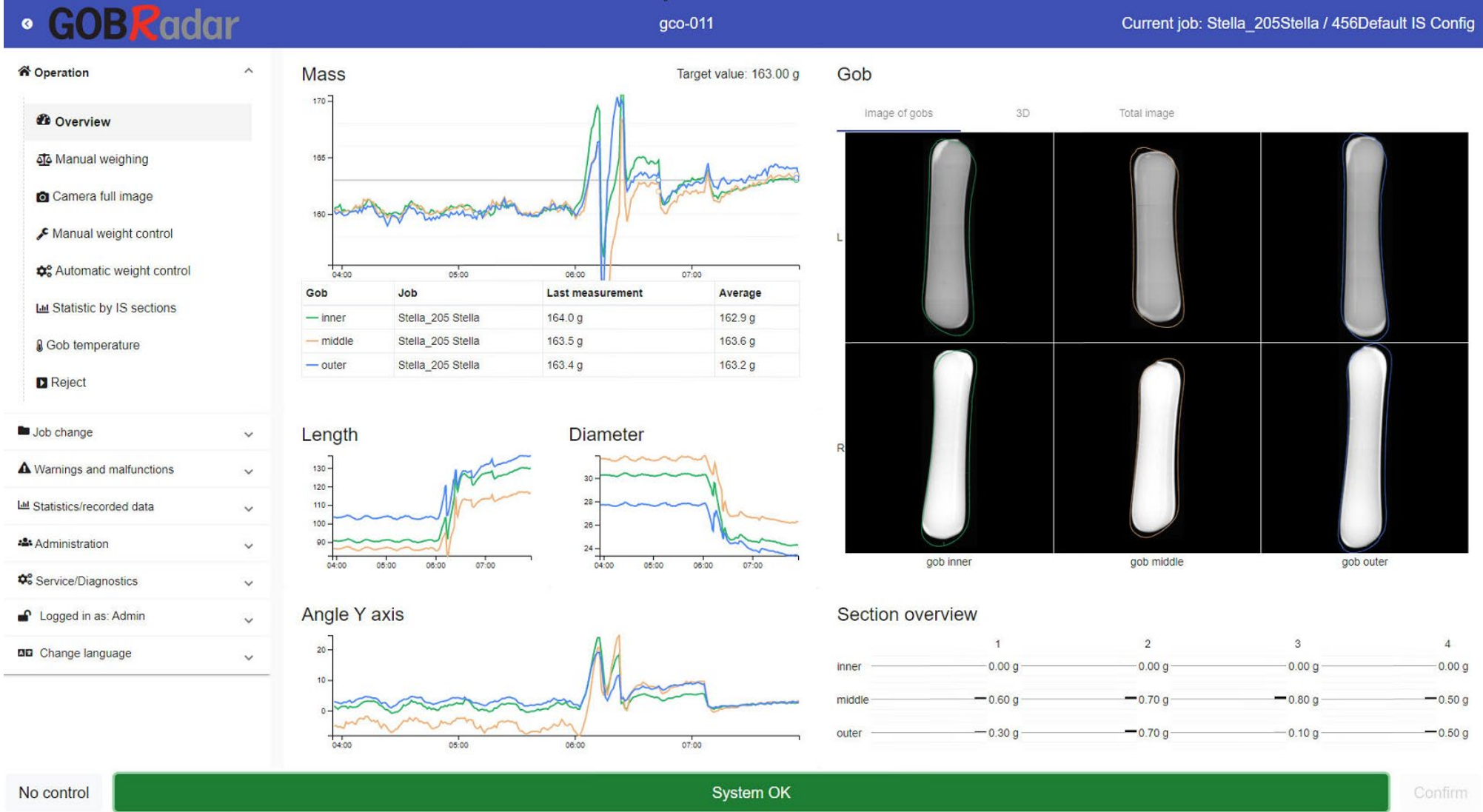
- **Positional Data**

- Tilt Angle
- Position – X, Y

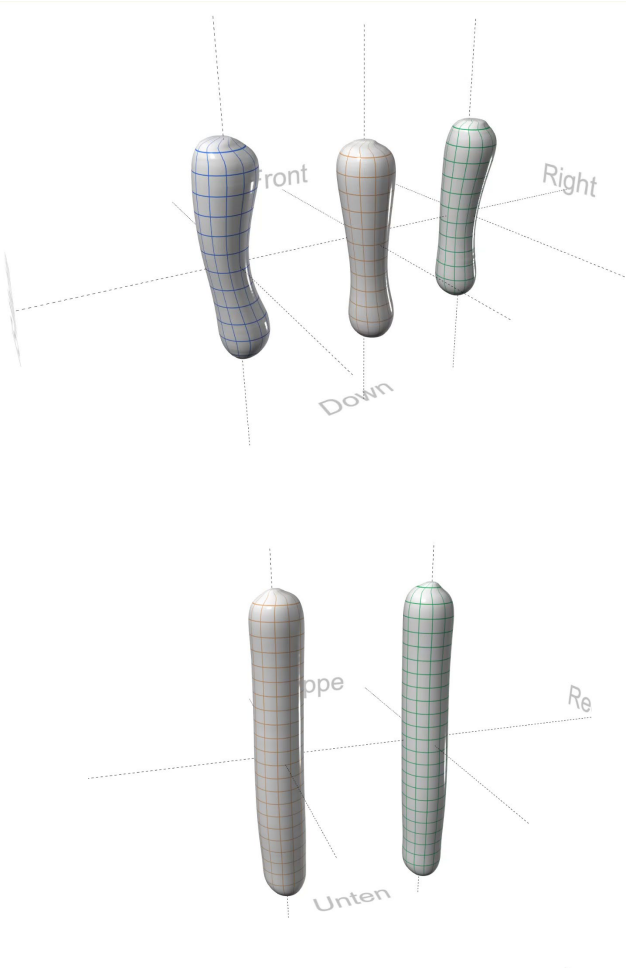
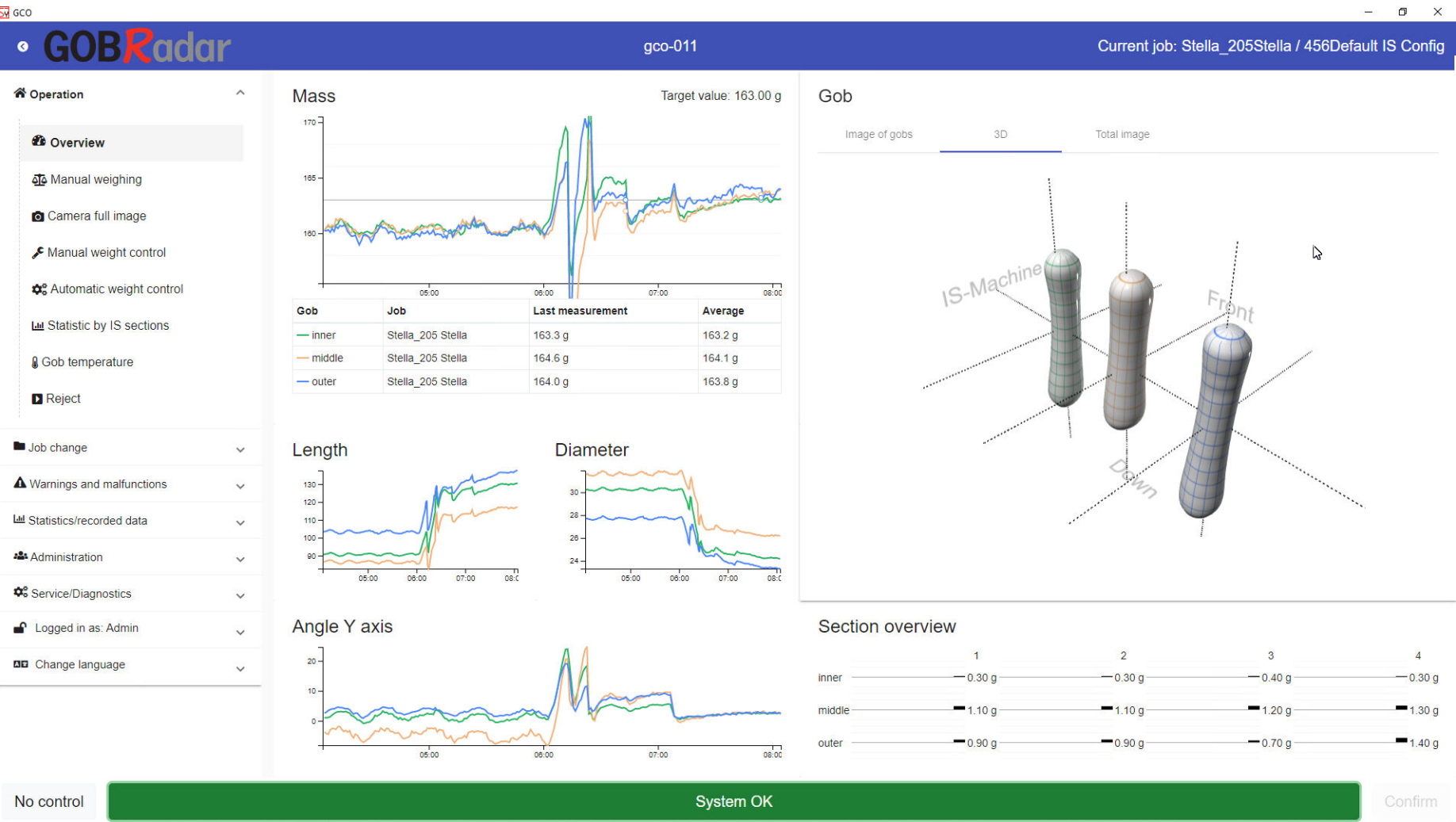
- **Other Physical Property Data**

- Temperature

Main screen with user-definable widgets



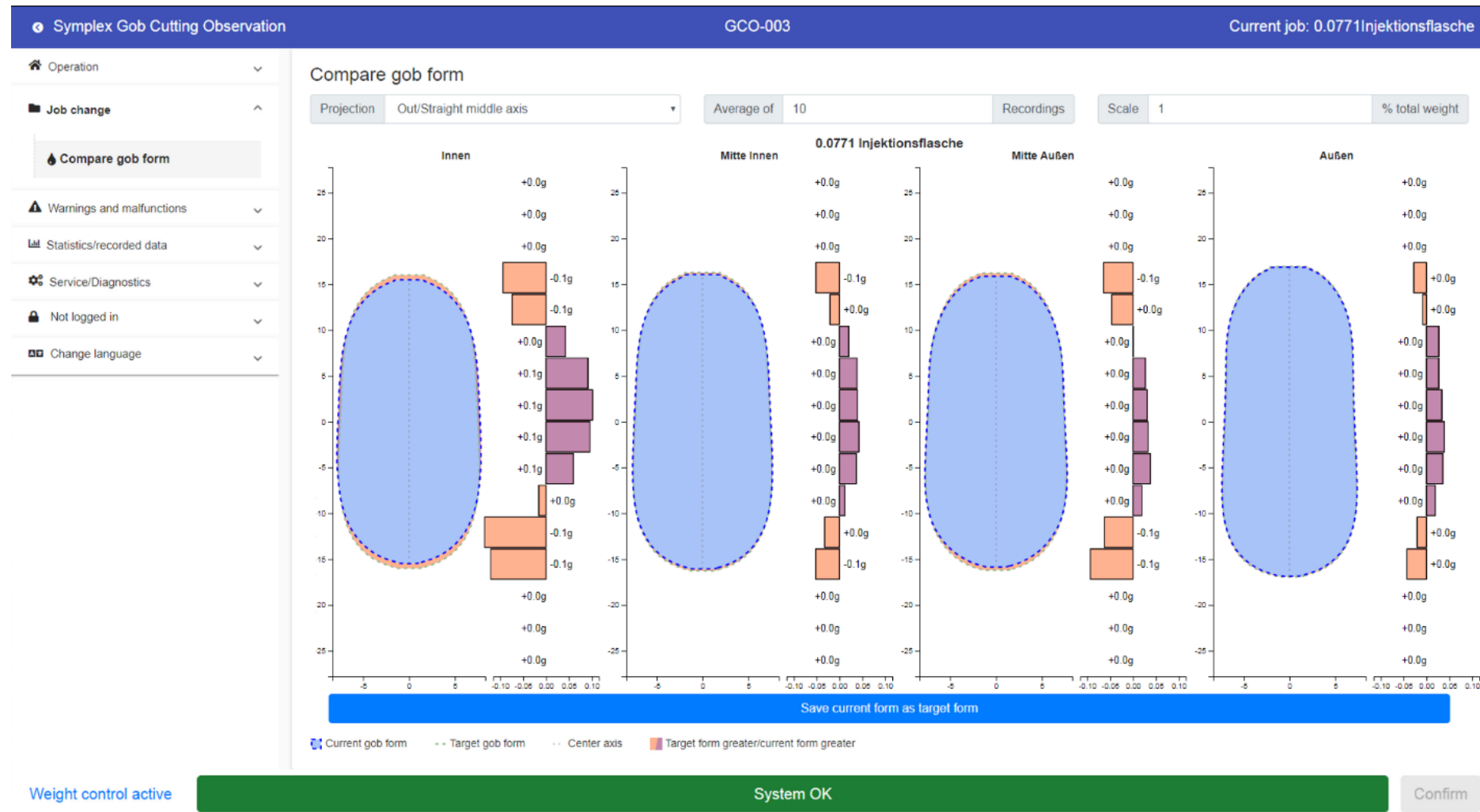
Main screen – 3D model



Compare gob shape – example quad gob

- **Save Reference Gob Image and Compare**

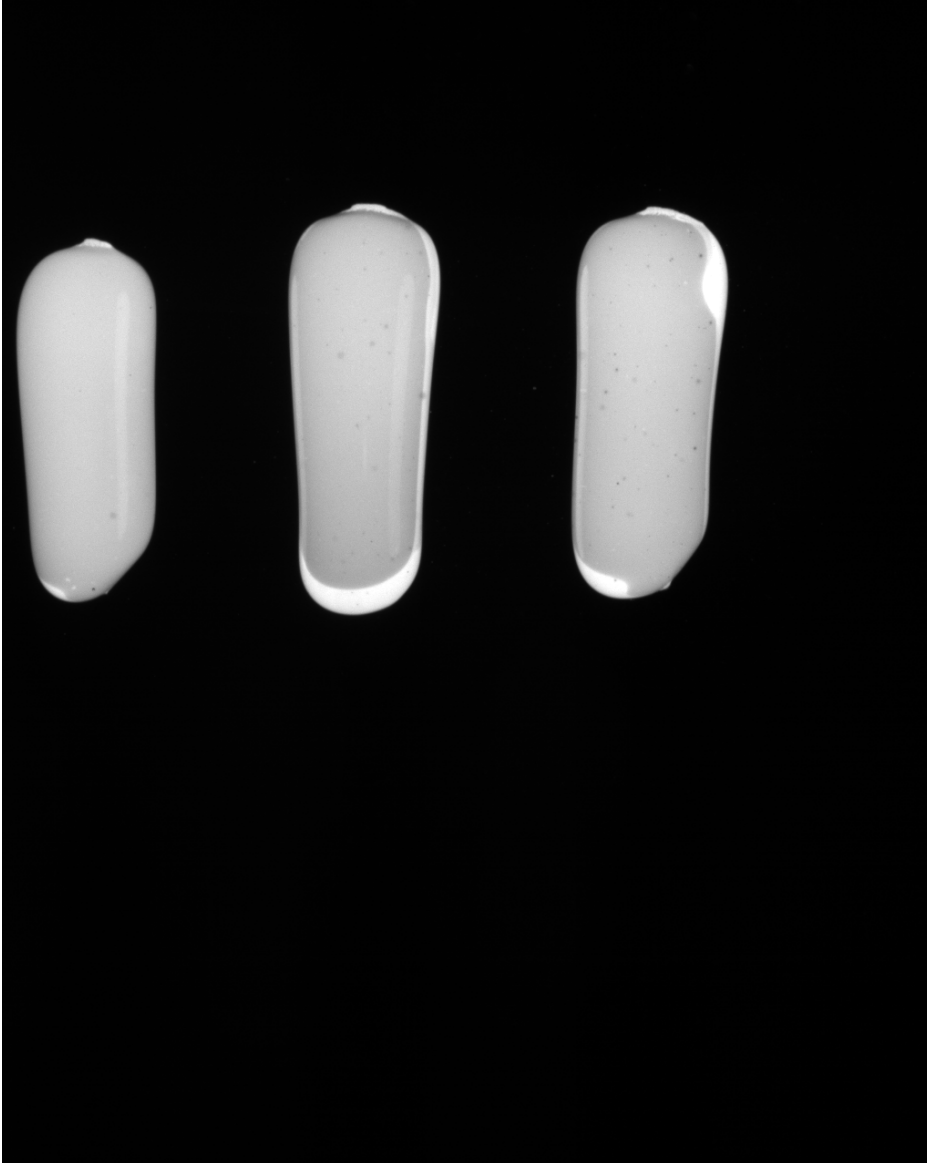
- Ex. Good production, high pack rate vs Later, more defects, lower pack rate



Compare gob shape – example double gob

- Save Reference Gob Image and Compare

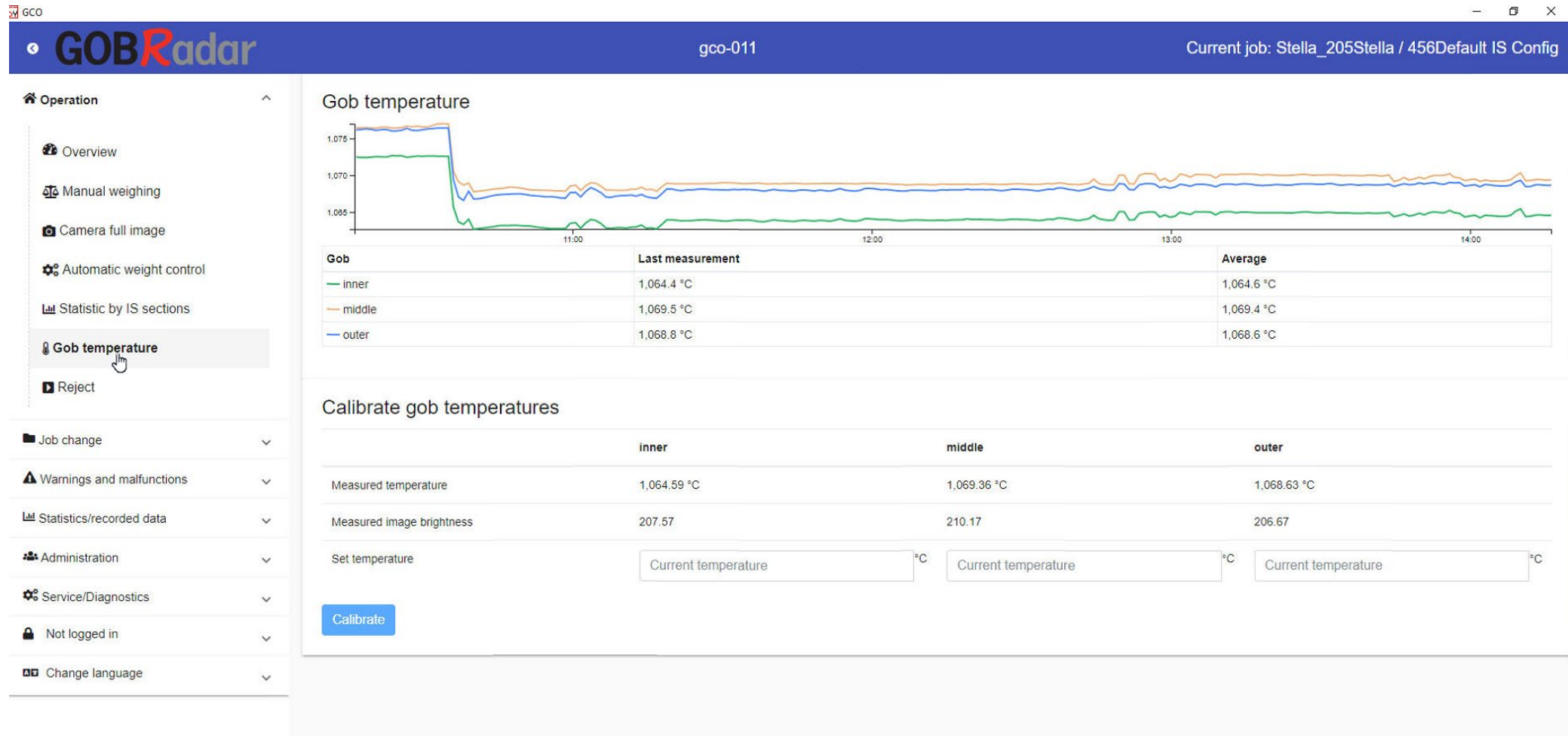




- Cameras measure light intensity
- Measured intensity can be used with known camera sensor response to calculate temperature
- Provides temperature estimates without the use of a thermal camera or pyrometer. Good for reference temperature if just interested in changes
- Can calibrate with gob optical pyrometer if want to show actual temperature

- Reference Temperature Measurement

- Temperature difference for changing processes: NNPB to BB; or Job to Job

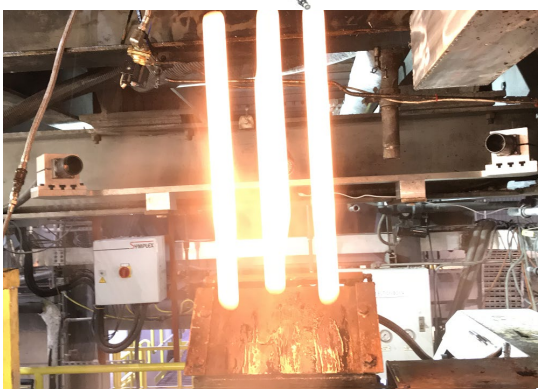
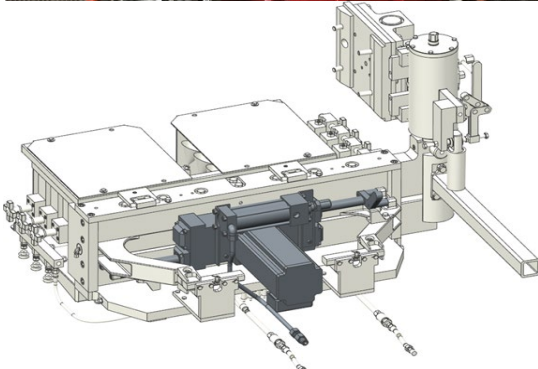
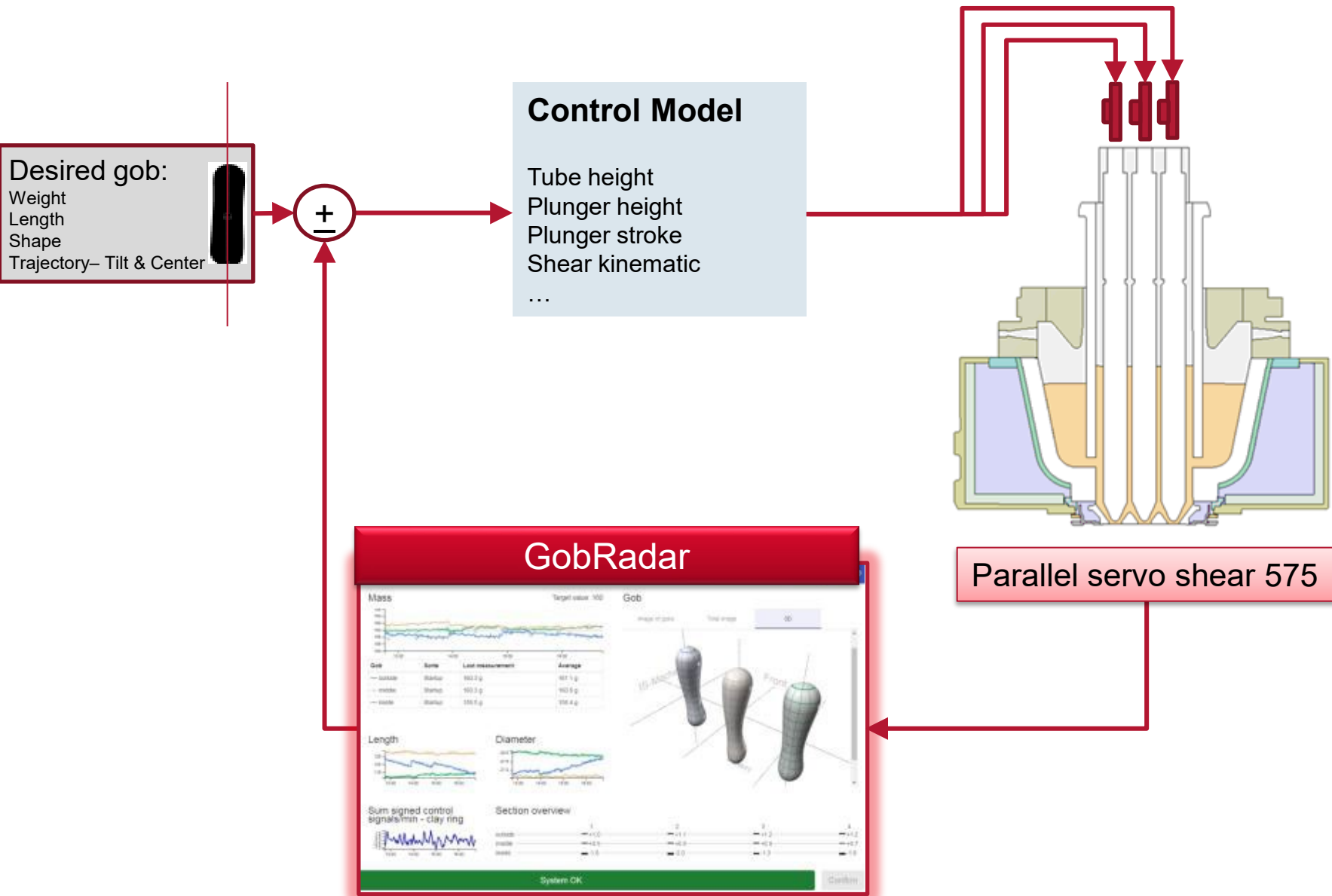


Closed Loop Control

Gob Radar providing feedback data for closed-loop control

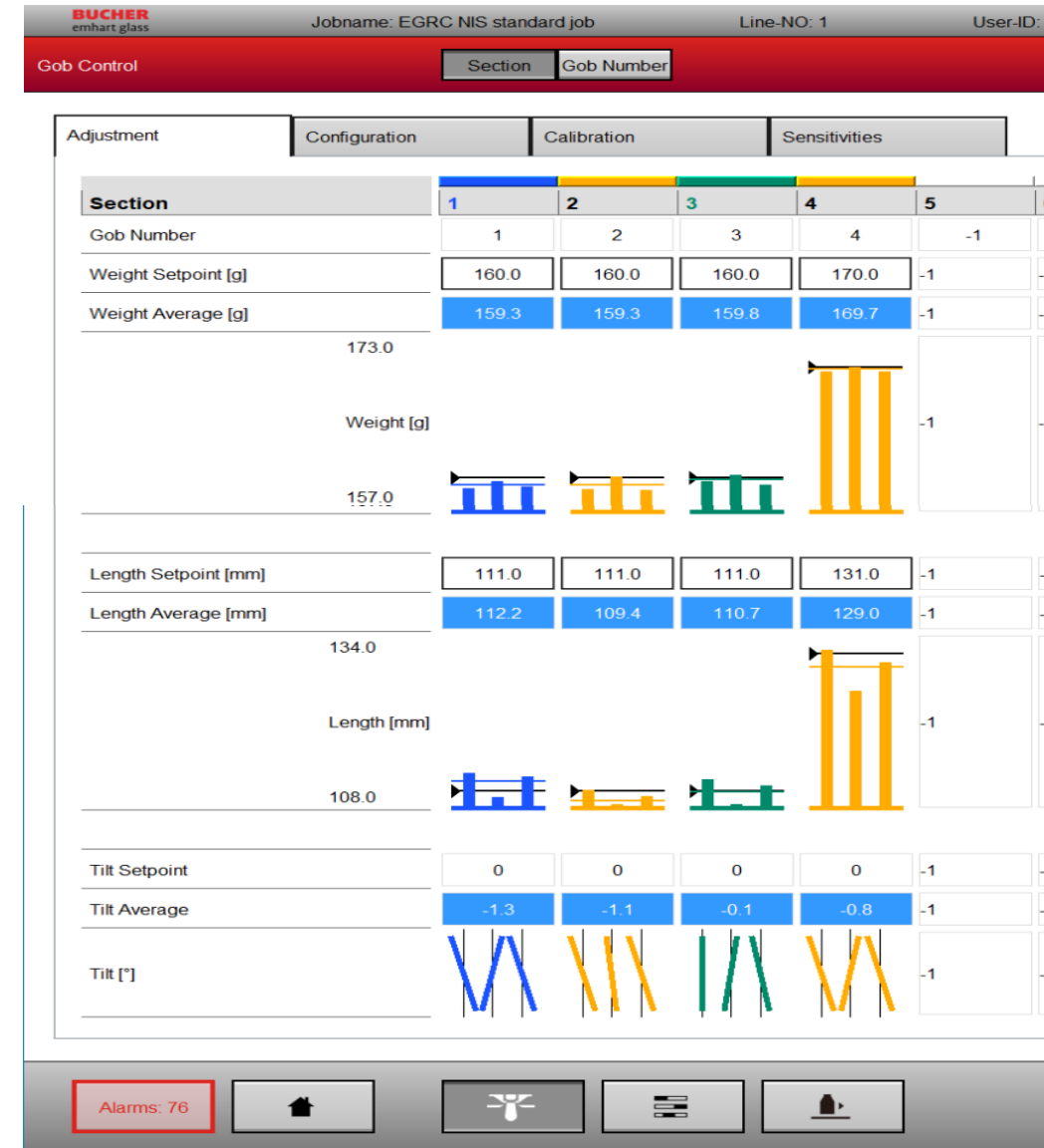
Smart Feeder Closed Loop Control

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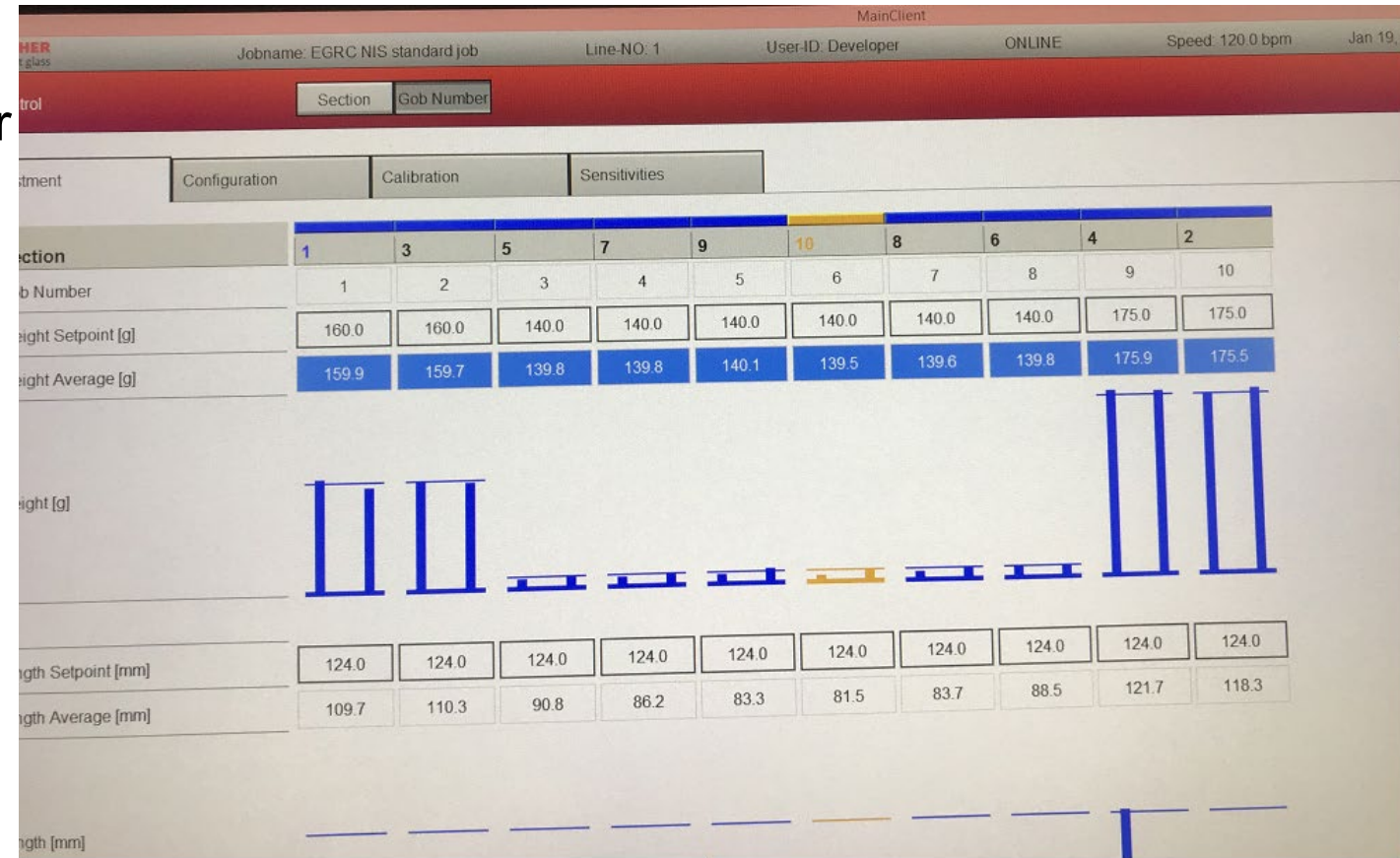
Smart Feeder Closed Loop Control

- **Single Gob Weight Production**
 - Setup 1 gob weight for machine
 - Maintain stable gob weight among cavities
 - Gob length balance across the whole machine
 - Correct gob tilt
- **Multi Gob Weight Production**
 - Setup and maintain gob weight for each section
 - Balance gob weight among cavities
 - Setup and maintain gob length for each section
 - Correct gob tilt



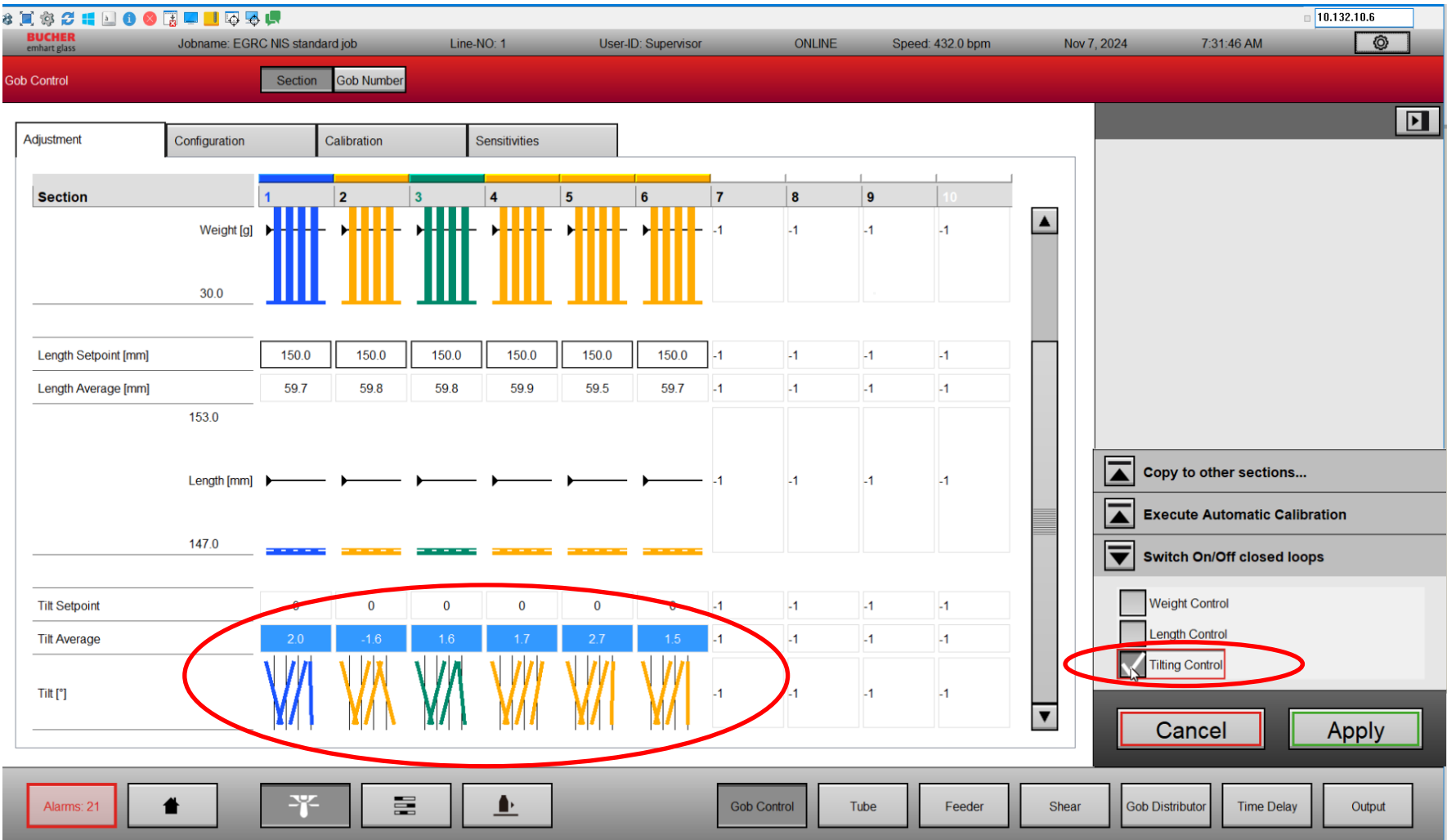
Smart Feeder Closed Loop Control

- Multi gob weights – 10 sections 3 weights
 - Allows most flexible production planning
 - DG BB ± 2 gms - most multi gob wt cases
 - TG NNPB $\pm .5$ gm – in Research Center



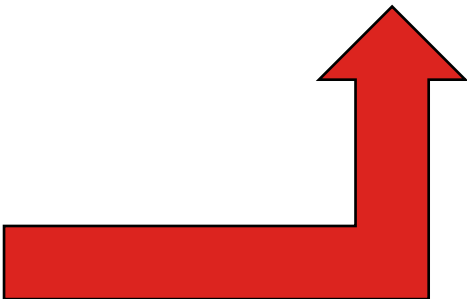
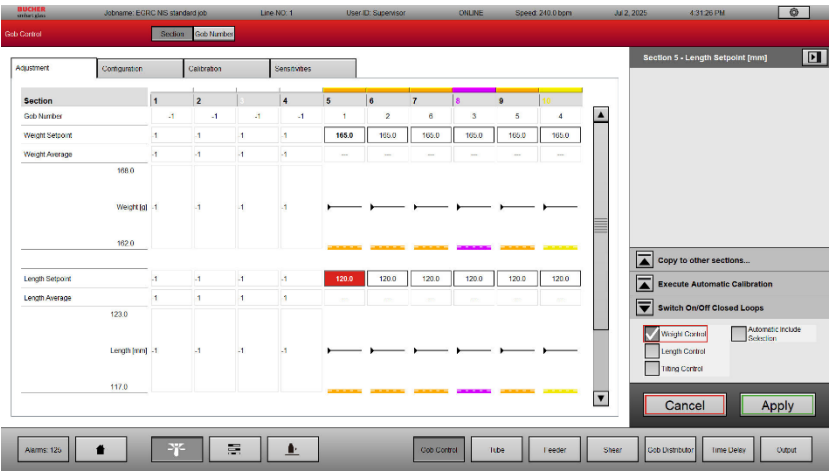
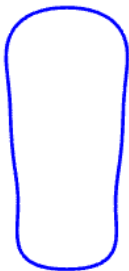
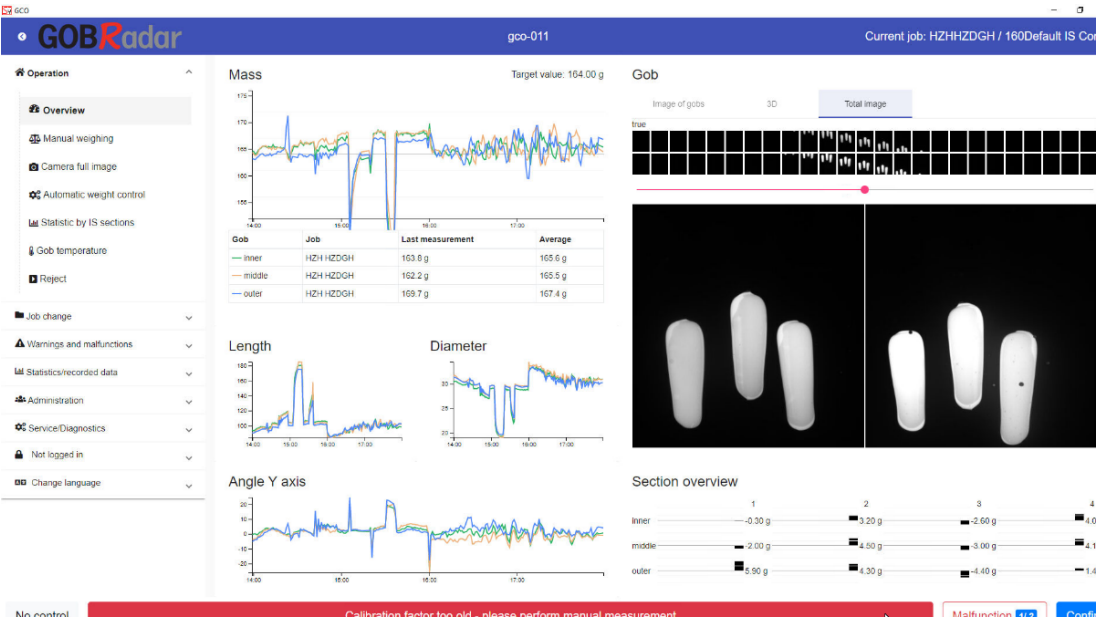
Smart Feeder Closed Loop Control

- Gob tilt control
 - Can be turned on at the same time as the other controls



Smart Feeder Closed Loop Control

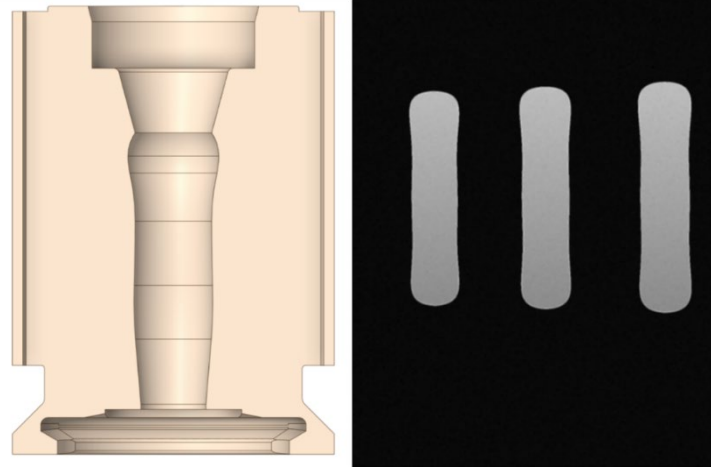
- Gob shape control – under development
 - Choose a weight and shape
 - Turn on control
 - Shape data from GobRadar provides feedback
 - Control changes gob shape while maintaining weight



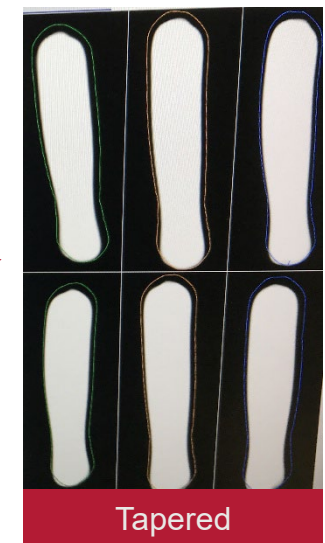
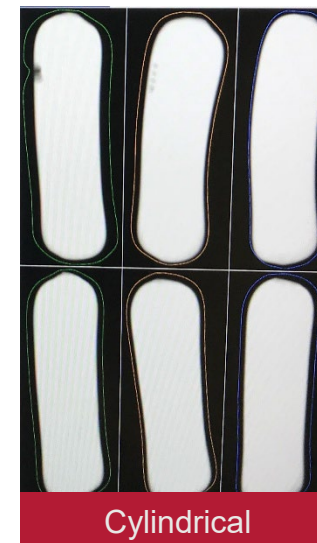
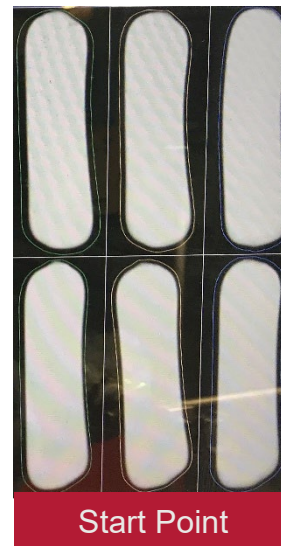
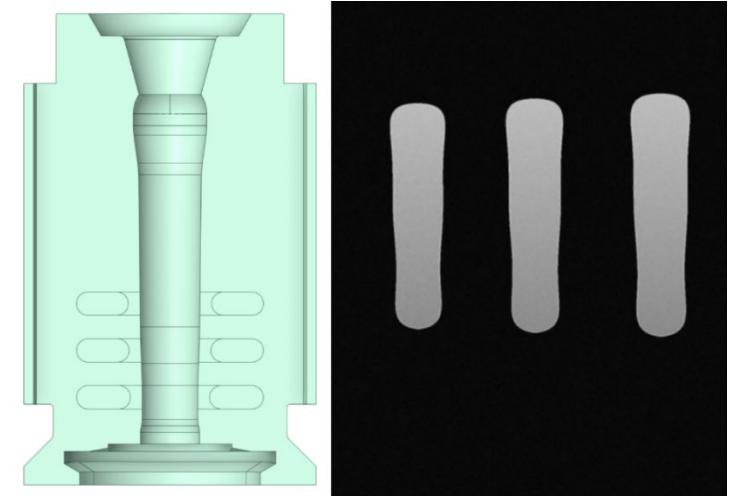
Smart Feeder Closed Loop Control

- Removes “Dog Bone” shape from gobs
- Can create different gob shapes to fit the process
 - Cylindrical – for NNPB
 - Tapered – for B&B
- Can control the amount of taper in the gob
 - Small taper vs Big taper

NNPB = Cylindrical Gob



B&B = Tapered Gob



Thank You!

Any Questions?

Tanner Kremer

