

ENERMAN-1

Power Measurement Prototype via Laser Beam Deflection



Maximilian Precht¹, Wolfgang Roland¹, Markus Brillinger², Bernhard Löw-Baselli¹, Georg Steinbichler¹

JKU-IPEC (Institut of Polymer Extrusion and Compounding)¹, Pro2Future GmbH²

¹ Science Park 2, Altenberger Straße 69, 4040 Linz, Austria

² Inffeldgasse 25f, 8010 Graz, Austria



MOTIVATION & GOALS

Injection molding and **extrusion** are the most common processing techniques in polymeric processing. Most of the **energy requirement** of these processes is **provided by the screw**. However, up to now, **no satisfying measurement technique** exists for measuring the **length-based torque** for single-screw extruders, which would provide profound insights for the process and can be used for **optimization**. Therefore, we developed a **laser beam deflection** screw torque measurement prototype and carried out a feasibility study.

Approached results:

- Very good agreement with the maximum screw torque given by the control system.
- New developed prototype for full axial measurement.

Project FactBox

Project Name Enerman-1

Project ID StratP 4.2.3

Duration 27 Months

Area_4.2

Cognitive Production Systems

Project Lead

Dr. Markus Brillinger

APPROACH

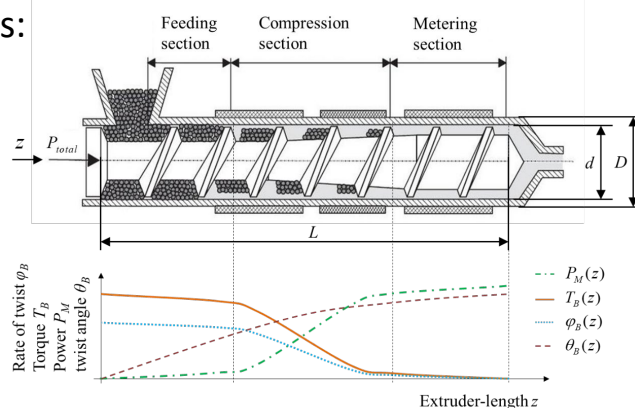
The screw drive power is **transferred** to the polymeric material, which is heated **due to friction** and **viscous dissipation**.

The torque balance gives:

$$T_S(z) = T_B(z)$$

$$T(z) = G \cdot I_P \cdot \varphi(z)$$

$$\varphi(z) = \frac{\partial \theta(z)}{\partial z}$$



CONTRIBUTION

Scientific contribution

Investigation method for axial energy input of the extruder, which gives a better insight in the extrusion process.

Validation method for new extruder models and screw designs.

Scientific publication of the measurement principle submitted

Economic contribution

New screw designs or screw designs tailored to a specific problem.

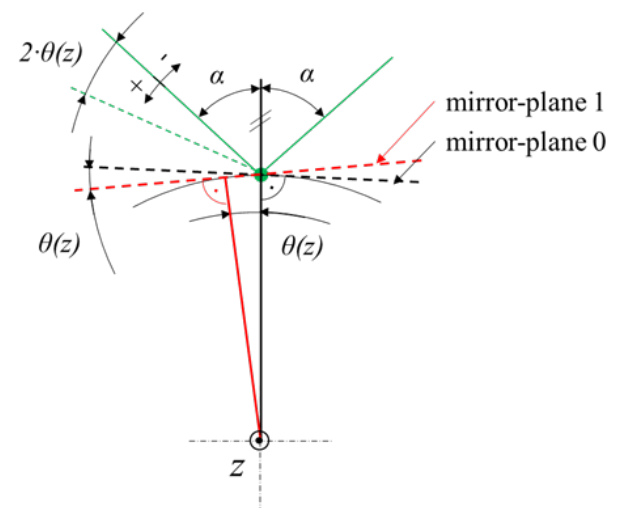
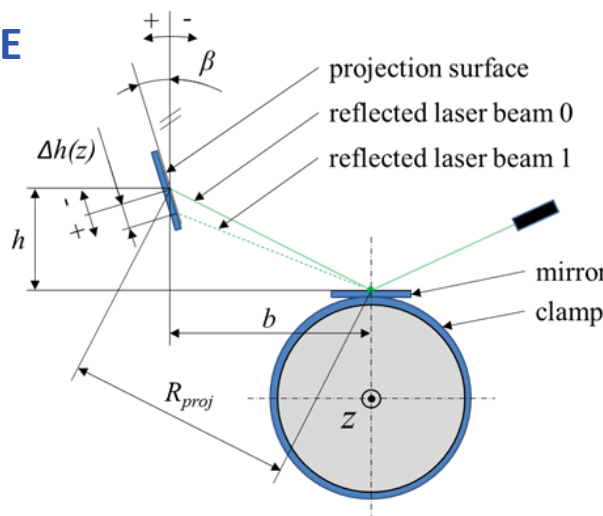
More energy efficient process control due to additional process information.

New models for efficient process settings.

SYSTEM ARCHITECTURE

Rate of twist is determined by **measurements of twist angle $\theta(z)$** on different axial positions.

This is done by a laser beam, which is reflected by a mirror attached to the barrel. In case of a change of $\theta(z)$, the change of the mirror plane would deflect the laser beam.



Contact: Dr. Markus Brillinger, Pro2Future GmbH, Markus.Brillinger@pro2future.at, +43 316 873 - 9156

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iPEC Institute of Polymer Extrusion and Compounding