Neutral Point Estimator PyRolL Plugin

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March 24, 2023

The PyRolL plugin pyroll-neutral-line-estimator provides different estimators for the neutral point which markes the point of zero shear stresses inside the roll gap.

1 Model approach

For rolling in grooves as for flat rolling, the neutral point is the point inside the roll gap where the shear stresses become zero. Hence, rolling is a three-dimensional forming process, the neutral point isn't a point but a curved plane inside the roll gap. For flat rolling as for groove rolling, the actual plane is often assumed as a point marking the horizontal coordinate inside the roll gap. In the case of groove rolling, Kunzman [1] stated that due to the spreading of the material the roll gap has to be divided into a forward-slip area, a backward-slip area as well as two areas which are called spreading areas. Figure 1 shows a simplified sketch of the areas during rolling.

The pyroll-neutral-point-estimator plugin provides different simplified solutions derived by different authors for flat rolling. Featured model equations are taken from Ford, Ellis, and Bland [2] and Bland and Ford [3], Sims [4], Siebel [5] as well as Bryant [6].

Since all of those solutions, derived from various simplified assumptions about the conditions inside the roll gap, are calculating the roll angle of the neutral point, the horizontal coordinate of the neutral point is calculated using equation 1.

$$x_n = -R_w \sin\left(\alpha_n\right) \tag{1}$$

2 Usage instructions

The plugin can be loaded under the name `pyroll_neutral_point_estimator`.

An implementation of the `neutral_point` hook on `RollPass` is provided. Furthermore, to decide which estimator is used the `pyroll.neutral_point_estimator.Config.ESTIMATOR` variable can be set according to table 1.

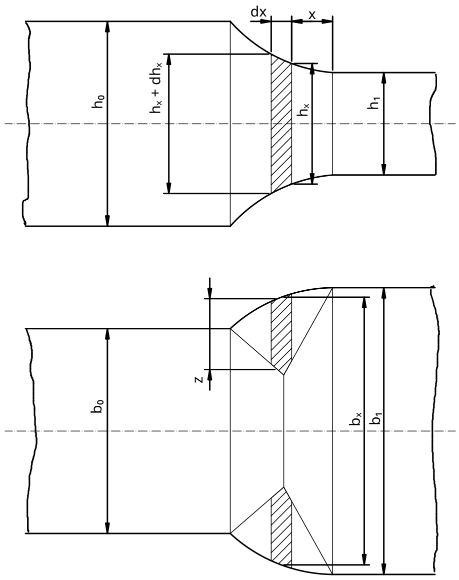

Figure 1: Neutral Plane for groove rolling

Table 1: Config variables for different estimators.

Estimator	Variable Name
Equal Solution	"EQUAL"
Ford-Ellis-Bland Solution	"FORD-ELLIS-BLAND"
Sims Solution	"SIMS"
Siebel Solution	"SIEBEL"
Osborn Solution	"OSBORN"

References

[1] Erich Kunzman. "Verfahrenoptimierung gezeigt am Beispiel des Streckkaliberwalzens". de. PhD Thesis. Technische Universität Bergakademie Freiberg, 1977.

[2] H. Ford, F. Ellis, and D. R. Bland. "Cold rolling with strip tension I - a new approxmate method of calculation and a comparison with other methods". In: *Journal of the Iron and Steel Institute* (1951). Citation Key: Ford1951, pp. 57–72.

[3] D. R. Bland and Hugh Ford. "The Calculation of Roll Force and Torque in Cold Strip Rolling with Tensions". en. In: *Proceedings of the Institution of Mechanical Engineers* 159.1 (June 1948), pp. 144–163. ISSN: 0020-3483, 2058-1203. DOI: 10.1243/PIME_PROC_1948_159_015_02.

[4] R. B. Sims. "The Calculation of Roll Force and Torque in Hot Rolling Mills". en. In: *Proceedings of the Institution of Mechanical Engineers* 168.1 (June 1954), pp. 191–200. ISSN: 0020-3483, 2058-1203. DOI: 10.1243/PIME_PROC_1954_168_023_02.

[5] E. Siebel. "Kräfte und Materialfluß bei der bildsamen Formgebung". de. In: *Stahl und Eisen* 45.37 (1925), p. 3.

[6] G. F. Bryant. *Automation of Tandem Rolling Mills*. 1st ed. London: The Iron and Steel Institute, 1973.