

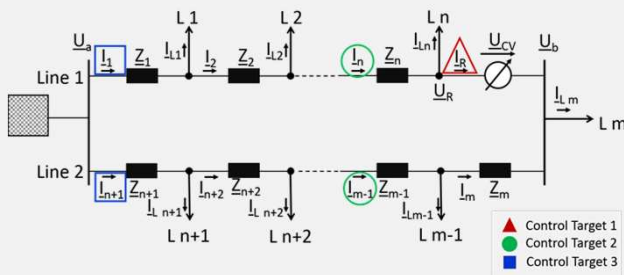
Spannungs- und Lastflussregelung mittels Schräg regler in vermaschten Niederspannungsnetzen

Integration zusätzlicher PV -
 Anlagen

Vermaschte Nsp.-Netze:
 Keine Spannungs- oder
 Lastflussregelung

Verhindert das Überschreiten von
 Spannungsgrenzwerten und
 Betriebsmittelüberlastungen

Spannungs- und Lastflussregelung in vermaschten Niederspannungsnetzen mittels **Flexiblen Ortsnetz**
 Spannungs- und Wirkleistungs-Regler (FLOW-R)



Realistic grid:

Restricted number of measurement points

Estimation of control voltage $\underline{U}_{CV}$:

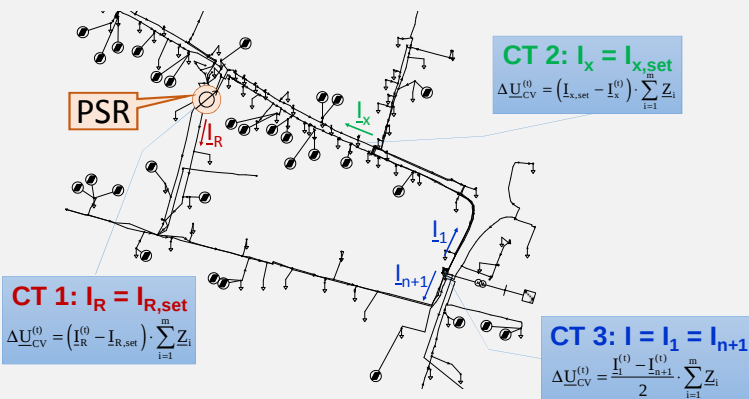
$$\underline{U}_{CV} = -\underline{I}_R \cdot \sum_{i=1}^m \underline{Z}_i - \sum_{i=1}^n \left(\underline{I}_{Li} \cdot \sum_{j=i}^n \underline{Z}_j \right) + \sum_{i=n+1}^m \left(\underline{I}_{Li} \cdot \sum_{j=n+1}^m \underline{Z}_j \right)$$

$$\Rightarrow \underline{U}_{CV} = -\underline{I}_R \cdot \sum_{i=1}^m \underline{Z}_i + \underline{U}_{LC}$$

Substitution for missing load currents $\underline{U}_{LC}$:

$$\underline{U}_{LC} = -\sum_{i=1}^n \left(\underline{Z}_i \cdot \sum_{j=i}^n \underline{I}_{Lj} \right) + \sum_{i=n+1}^m \left(\underline{Z}_i \cdot \sum_{j=n+1}^m \underline{I}_{Lj} \right)$$

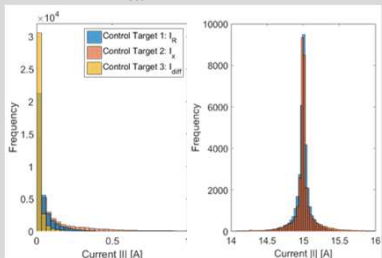
3 basic control targets for current control



Continuous Regulator

- Power electronics required

Szenario A: $I_{set} = 0 \text{ A}$ Szenario B: $I_{set} = 15 \text{ A}$



Discrete voltage
 and angle steps:

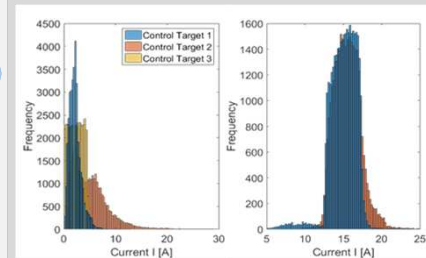
$$\Delta U_{CV} = -8\% \dots 8\% \text{ in } 0.2\% \text{ steps}$$

$$\Delta \varphi_{CV} = 0 \dots 330^\circ \text{ in } 30^\circ \text{ steps}$$

Discrete Regulator

- Deviation of CT $\sim 5 \text{ A}$
- Low cost transformer technology

Szenario A: $I_{set} = 0 \text{ A}$ Szenario B: $I_{set} = 15 \text{ A}$



Prototype Development



Power flow and voltage control in meshed LV
 grids by impressed control voltage

Further integration of renewable generators

Less classical network extension