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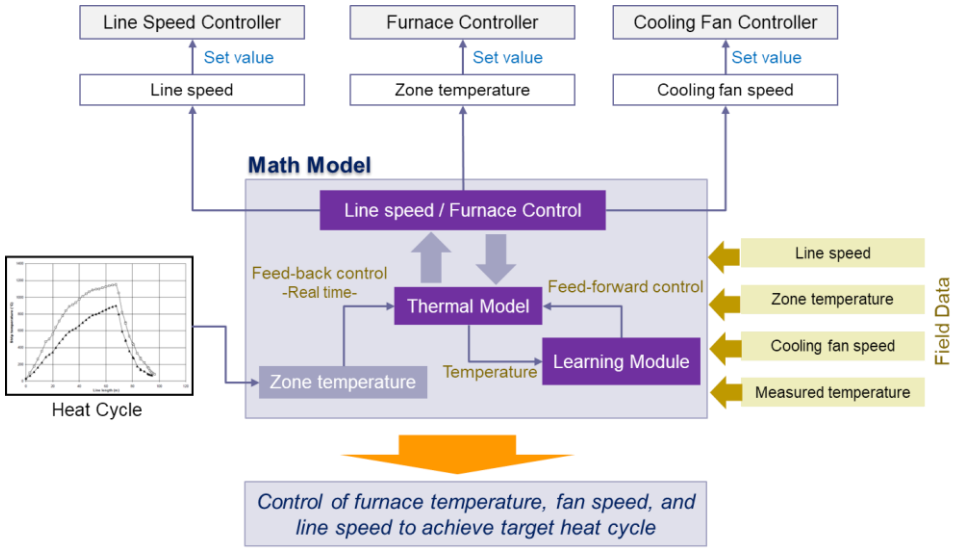
Advanced Strip Temperature Control System

ST-OPTIMIZER

ANN(Artificial Neural Network) based strip temperature control system for a continuous annealing process

ST-OPTIMIZER has been developed to achieve the desired strip quality by controlling strip temperature during continuous annealing process, especially in transient furnace operations. Due to high thermal inertia of the furnace and frequent transient furnace operation from various kinds of steel grade or process conditions, it is not easy to get high accuracy of control to keep exact strip temperature according to predefined one. ST-OPTIMIZER is an advanced control system that ensures accurate control of strip temperature in any transient furnace operations by using combined math model, feed-back control, and feed-forward learning control modules.

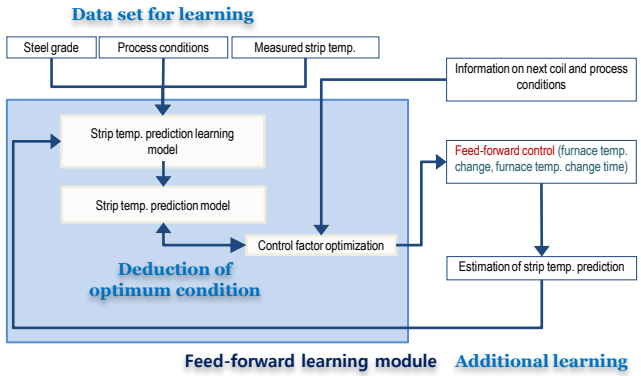


Features

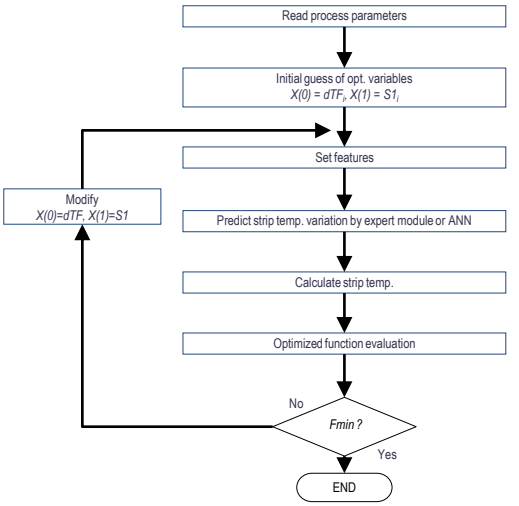
- On-line thermal tracking math model (based on Finite Element Method)
- Tracking actual process conditions (strip width, thickness, line speed, steel grade, furnace temp. etc.) for math model calculation
- Emissivity tuning by real time feed-back control
- Using PID control for controlling strip temperature
- Feed-forward control based on learning module in case of transient operations
- Strip temperature prediction by expert or artificial neural network learning module for transient operations
- Optimization of control factor to keep strip temperature in the target range
- Optimization of strip temperature profile to keep it in the target range for transient operations
- Automatic optimization of control factor and strip temperature profile for a new transient operation
- High accuracy of strip temperature control by combining feed-back and feed-forward learning control efficiently
- Much higher reliability and accuracy proven than highly skilled manual operation
- Functional and flexible GUI of server and client program

Strip Temperature Control Procedure

- Learning by expert or ANN based on a given data set
- Control factor optimization based on the transient process condition and strip temperature prediction model
- Feed-forward dynamic control using optimized control factor
- Comparison of strip temperature prediction and measured one
- Automatic relearning based on the new data
- PID control and real time emissivity tuning during feed-back control



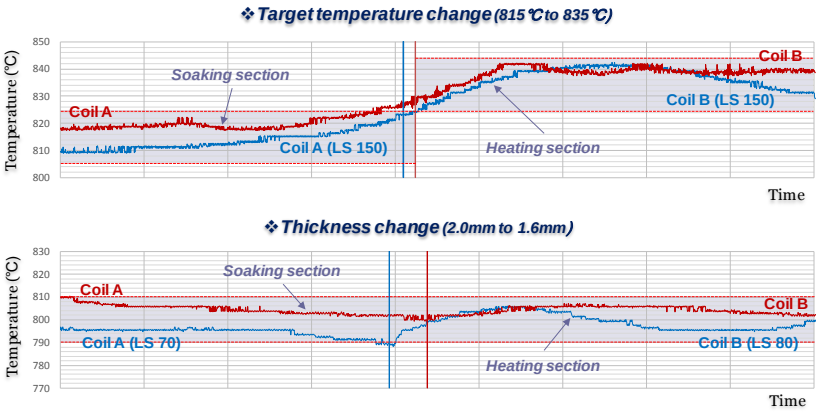
Feed-forward Learning Control to Strip Temp. Control



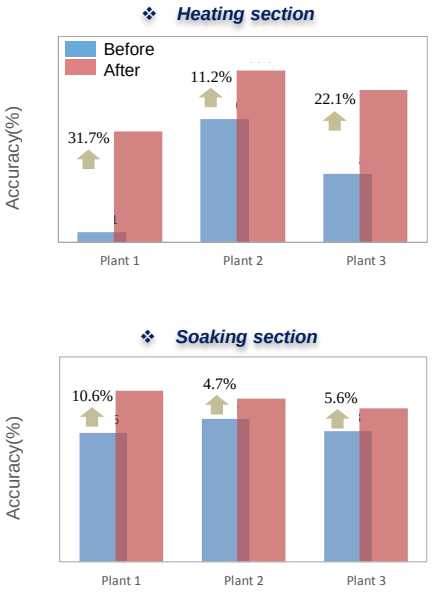
Control factor optimization flow chart

Plant Application and Performance

- Much higher reliability and accuracy of control than skilled manual operation particularly for severely changing condition
- **Control accuracy improvement in heating section :**
  Plant 1) 31.7% improvement, Plant 2) 11,2% improvement, Plant 3) 22.1% improvement
- **Control accuracy improvement in soaking section :**
  Plant 1) 10.6% improvement, Plant 2) 4.7% improvement, Plant 3) 5.6% improvement
- Automation rate more than 95%
- Improvement in product quality, production cost, productivity, and the efficient operation



Examples of Controlled Strip Temp.



Performance

Requirements

- System H/W : Workstation or higher (CPU : 2.0 GHz, RAM : 4 GB, HDD : 200 GB or higher)
- Operating System : Windows 7 or higher (32/64 bit)
- Network : TCP/IP networking with Level2, DCS, and line PLC system
- Client PC : Desktop or Notebook PC
- Can be changed by situation of inventories at ordering time or user requirements

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