



 Federal Ministry  
Republic of Austria  
Education, Science  
and Research

Christian Doppler  
Forschungsgesellschaft 

# Simpler control of complex processes

Comprehensive physical models allow production facilities to be controlled in real time, increasing efficiency and enhancing quality.

## What is at issue?

In modern steel production the key process correlations of the production facilities are well known. Due to the large number of existing process parameters, the complexity of the facilities and the inability to describe the effects of the operating environment in detail, further advances in process control can only be achieved with considerable mathematical effort. For that reason, voestalpine Stahl GmbH is interested in scientifically developed, mathematical models and algorithms which allow optimal process management and real-time control of their facilities. This, in turn, allows the company to use resources more efficiently, increase product quality and step up production output, while at the same time reducing the impact on the facilities themselves and on the environment.

## The research question: Adequate process descriptions

In order to optimally control production facilities in real time, physical models are needed which also work under real production conditions. These tailor-made models use simplified equations to describe a process in sufficient detail for it to be applied in practice.

CD Laboratory for Model-Based Process  
Control in the Steel Industry

## Head

Univ.Prof. DI Dr. Andreas Kugi; Vienna  
University of Technology

## Duration

01.01.2014 – 31.12.2020

## Company partner

voestalpine Stahl GmbH

# Three questions for ...



**Dr. Franz Androsch**  
Head of R&D at voestalpine AG

## *Why is basic research so important for innovation?*

When developing new materials and processes, application-oriented basic research is vital in order to gain a thorough understanding of newly emerging

phenomena and the correlations between them. Metallurgy and materials science have become a highly complex field of science. These days technological leadership without basic research is almost unthinkable. In many cases, basic research is a necessary supplement to corporate research, by facilitating or speeding up the development of new processes and products.

## *What are the major challenges in collaborating with universities?*

Scientific partners, especially university institutes, are very important because they undertake the basic research that we can't do ourselves. We strive to work with scientific

partners along our entire process chain, establishing long-term partnerships in key areas. This collaboration is always a partnership of equals, and is designed as a win-win situation for both parties. We benefit from the expertise and resources at the institutes, which are also a source of new and highly-qualified employees. In turn, the institute profits from the relevant research tasks and the financial support provided by the company.

## *What do you value most about the CD Laboratory funding model?*

CD Laboratories are unbureaucratic and highly flexible. Being able to set up new modules, add extra partners and

adapt the budget, all during the course of the project, makes it possible to react quickly to new developments or changing parameters. The model is uncomplicated, has specified rules, clearly formulated goals and a defined duration. The 30% allocation for basic scientific research is also a huge advantage for the company. It allows the scientific staff in the CD Laboratory much more freedom to explore the scientific principles, and is an advantage over bilateral projects in contract research which have an exclusive focus on applied research as well as pressure for results.

This approach makes it possible not only to intervene in ongoing production processes based on selective measurement data, but also to understand and directly control the process as a whole. Examples of specific applications for such models include the manufacture of steel plates in the hot strip rolling mill and during hot-dip galvanising.

### **Example: The hot-dip galvanising line**

The hot-dip galvanising process adds a corrosion-resistant surface coating to the steel strip, rendering it suitable for use in sectors such as the automotive industry. During the galvanising process the strips are drawn through a zinc bath, with the thickness of the zinc coating subsequently adjusted by gas wiping jets mounted on both sides. The zinc bath mechanism can cause the strips to oscillate, resulting in variations in the thickness of the zinc coating. As zinc is a relevant cost factor, the thickness of the coating must be limited to the minimum necessary. Therefore the goal is to control the passage of the strip through the zinc bath using electromagnetic actuators in real time in order to avoid oscillations. The first research projects in this field have already been concluded. Now the company is implementing the outcomes. voestalpine Stahl GmbH believes this will lead to considerable savings.

### **Example: The hot strip rolling mill**

The slabs produced on the continuous casting line are heated to over 1.000 °C in the hot strip rolling mill before being rolled into strips. Based on the research undertaken in the CD Laboratory, a thickness feedforward control has been developed which uses measurements taken on the rolling mill roughing stand to improve the quality of the strips leaving the rolling process. This reduces the high production costs of rolling.

## **Scientific challenge**

Industry can only remain competitive when complex production facilities are highly automated. This relies on scientific developments in automation and control technology which generate new knowledge, new methods and algorithms, such as the mathematical modelling of dynamic systems and real-time optimisation. Particular attention is paid to ensuring that the new methods are both relevant and applicable in practice. This requires expertise in a range of areas, especially electrical engineering, computer sciences, mechanical engineering, mechatronics and process engineering. The results of this basic research can be applied in many continuous production processes, in the metal, plastics, paper and food industries, among others.

## **Added value for the company**

The implementation measures, which have already been realised and planned, have led to a marked increase in efficiency at the hot strip rolling mill and hot-dip galvanising line. Major savings are expected in raw materials, energy and maintenance costs.