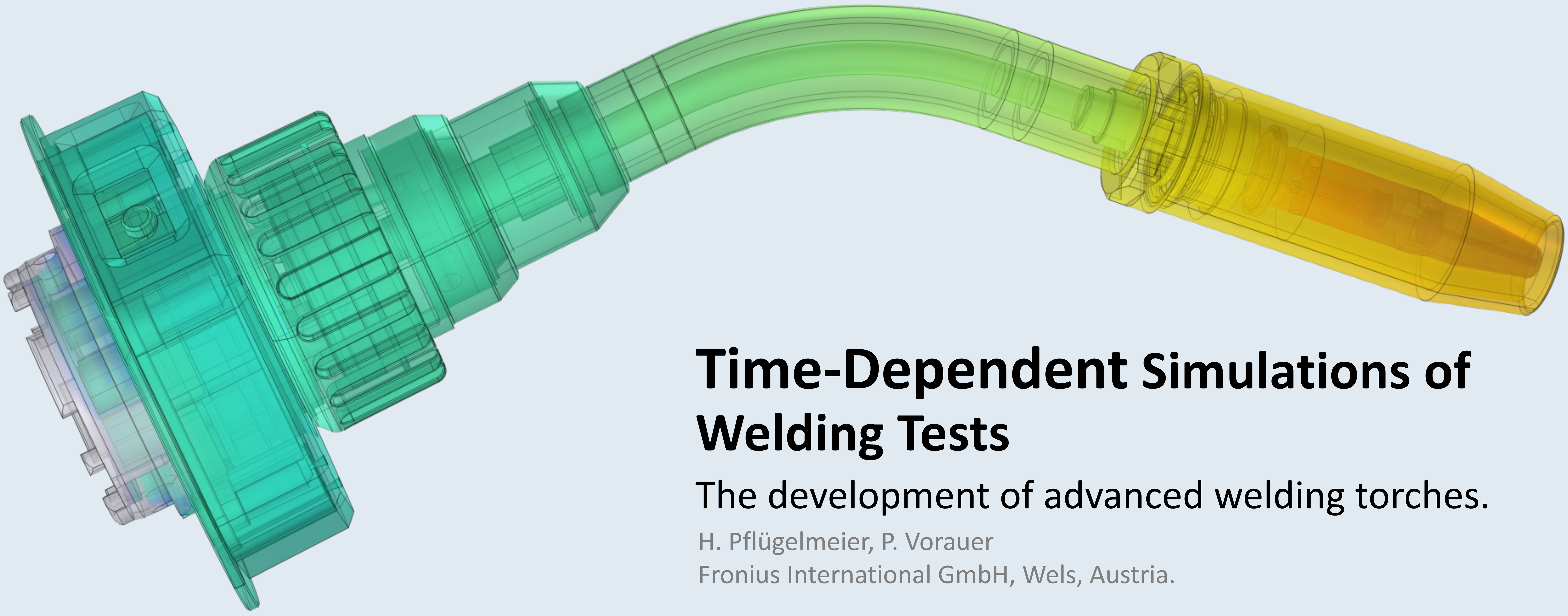

Time-Dependent Simulations of Welding Tests

The development of advanced welding torches.

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Introduction

The development and testing of advanced welding torches requires optimizing design and performance while minimizing costs and environmental impact. Traditionally, this has involved extensive physical testing, which is both time-consuming and resource-intensive.

To streamline this process, we use COMSOL Multiphysics® simulations, reducing the need for physical testing and accelerating development.

A series of thermal simulations were created using the heat transfer in solids physics module to calculate the heat fluxes inside the torch and to predict temperature differences.

Due to the operational characteristics of welding torches and the heat generated during the process, it is necessary to shut down the torch after a specified period to allow it to cool. This shutdown was modeled using the events feature of the mathematical ODE and DAE interface.

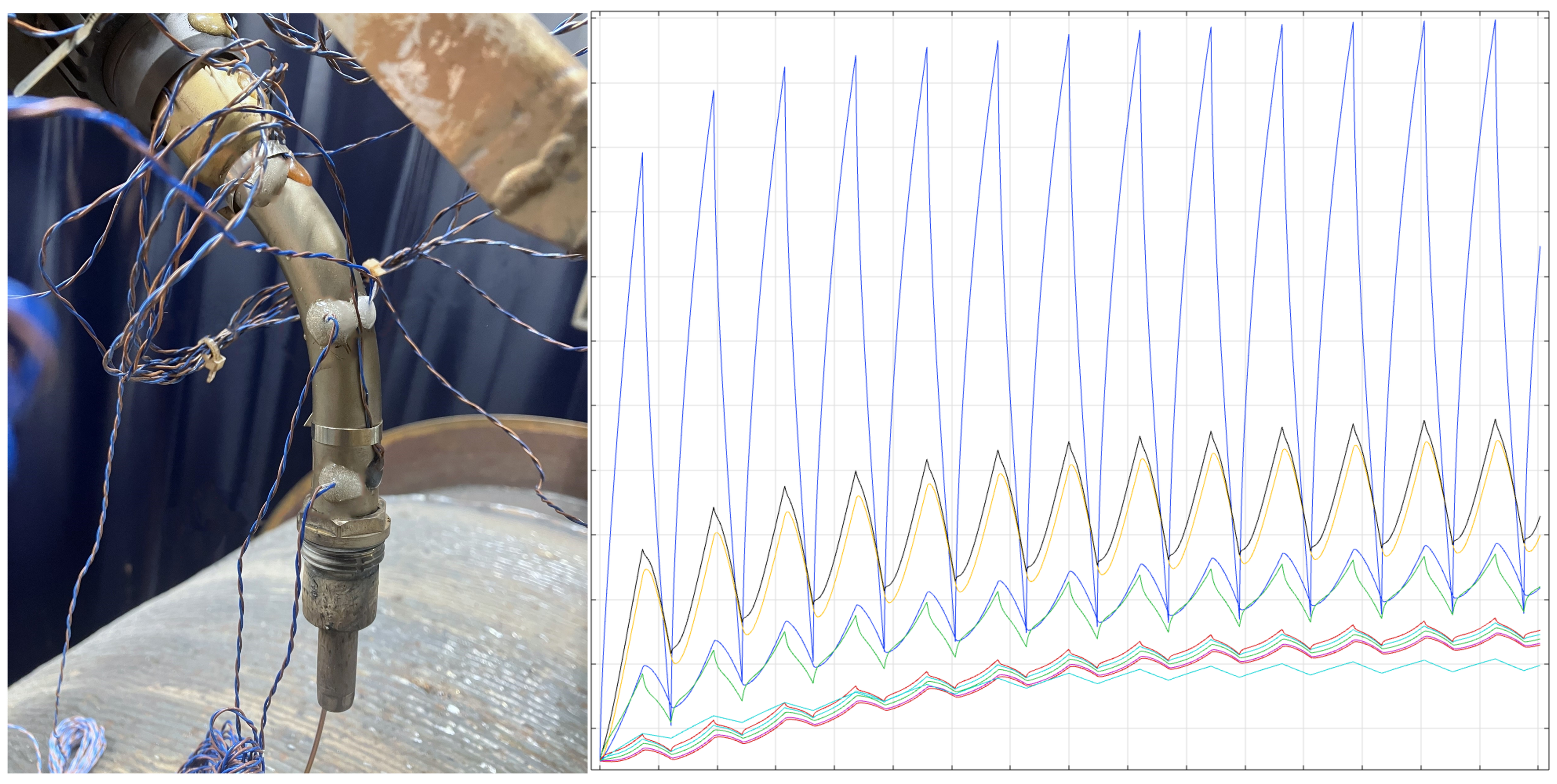

FIGURE 1. Measuring the temperatures by the welding test (left). Temperatures over time from different parts inside the torch in dimensionless units based on °C (right).

Methodology

The process began with welding tests, focusing on measuring temperatures over time in the torch. Following this, the heat flux was analyzed by calculating the heat transferred through the pipe bend.

A thermal simulation of the welding torch was then created, calibrated, and validated against the experimental test results. This simulation also included modeling the torch's cooldown phase during the welding process. In this phase, the heat flux entering the torch, primarily generated by the welding arc, is shut off for a predefined period, causing the torch's temperature to decrease.

The simulation provides the temperature profile over time, showing how the torch's internal temperature changes.

Results

The thermal simulation for various torch geometries provided a comprehensive analysis of temperature distribution and variations.

It forecasted how heat is distributed across different designs and calculated the temperature differences between them. This simplifies obtaining the internal temperature of the torch without the need for complex test and measurements. The simulation also tracked temperature changes over time for each geometry, allowing for a detailed understanding of thermal behavior.

Additionally, it identified optimal placement for temperature-sensitive components to minimize thermal stress and evaluated the effectiveness of thermal conduction in managing heat dissipation.

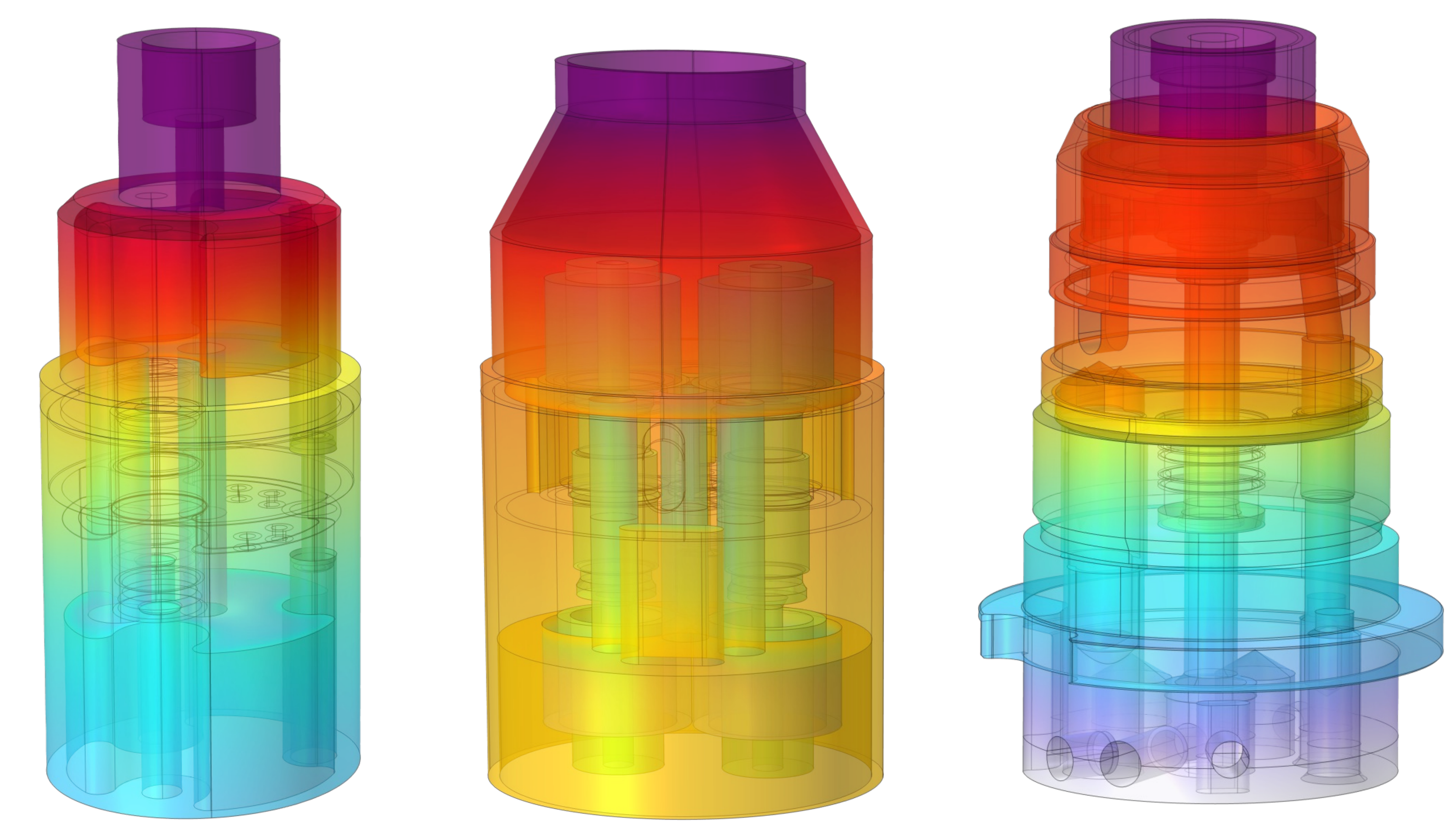

FIGURE 2. Temperature Distribution Across Various Torch Geometries Tested with the Model in dimensionless units based on °C

REFERENCES

Fronius International GmbH, Wels, Austria.

Leading innovator in the fields of welding technology, photovoltaics, and battery charging technology. https://www.fronius.com/de-at/austria

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