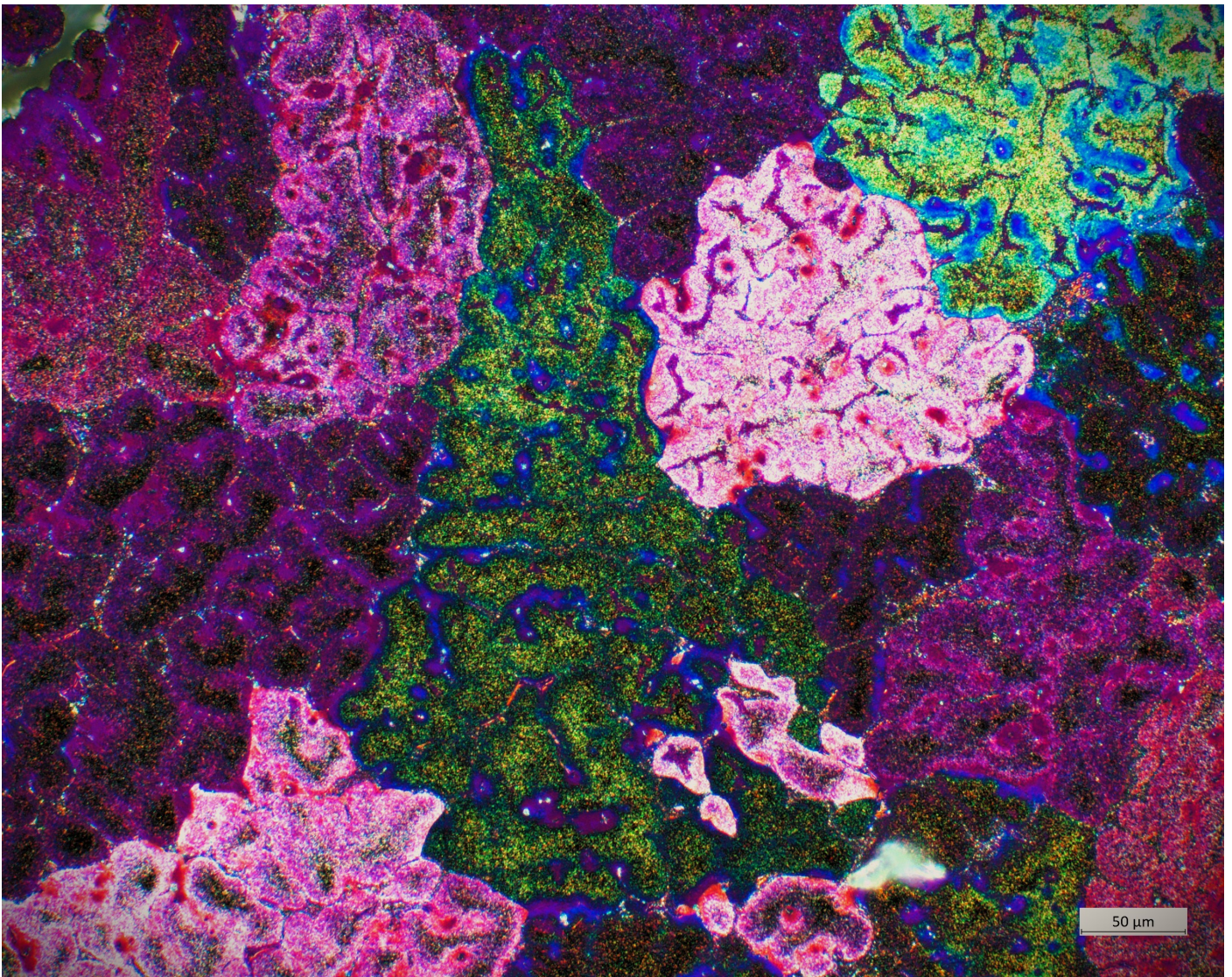


# utg Newsletter Issue 11

12/2024

Chair of Metal Forming and Casting



**„You should never have so much to do  
that you don't have time to think.“**

Georg Christoph Lichtenberg (1742-1799), German physicist, mathematician and writer

# Editorial

Dear friends and partners,

With best wishes in the run-up to Christmas, I would like to present you with our latest newsletter. As usual, we have summarized current events around the chair as well as some selected research results from the forming, stamping and casting group.

A very formative experience in the second half of the year was the academic exchange with two Chinese universities. In addition to a visit from a group of students from Tongji University (Shanghai), we had the opportunity to accept a return invitation to Shanghai.

I was able to see for myself the high level of production engineering research that has now been achieved in China. The atmosphere was very open and friendly, so that I returned with many impressions and a high level of motivation. In order to continue to be recognized in international research, we have to move forward with maximum speed and innovative strength.

In this context, I am of course also very much looking forward to the academic exchange at NUMISHEET 2025, which we will be hosting as *utg*.

So enjoy reading and best wishes for a successful 2025 from the *utg* Chair

Yours



Wolfram Volk



Prof. Dr.-Ing. Wolfram Volk

Photo: Heddergott/TUM

**Cover picture:**

AlMgMn alloy. Investigations into the usability of aluminum scrap in foundry technology.

Micrograph: double etching magnified 200x with polarizing filter.

Photo: Corinna Sutter/*utg*

# utg News

## Exchange with Shanghai

### Tongji University Summer School at utg

Sixteen students from Tongji University in Shanghai spent a day with us at *utg* as part of their summer school in Germany. They were able to find out first-hand about our teaching and research priorities. To keep things from getting too theoretical, we also offered our Chinese guests the opportunity to gain practical insights into the measurement of residual stresses in a workshop.



Students from Tongji University at the *utg*, Photo: *utg*

### Delegation from the China Auto Lightweight Technology Innovation Strategic Alliance (CALA) at the *utg*

In November, a delegation led by Junying MIN from Tongji University in Shanghai visited us. The guests traveled through Europe as representatives of the CHINA AUTO LIGHTWEIGHT TECHNOLOGY INNOVATION STRATEGIC ALLIANCE (CALA). The *utg* was the only TUM institution on their packed itinerary.

Junying MIN first gave an overview of the current development trends in the Chinese electric vehicle industry, after which Wolfram Volk introduced the *utg* and its research focus.

Both sides engaged in a lively discussion about the application and development prospects of giga-casting in the automotive industry. Finally, Wolfram Volk gave the CALA delegation a tour of the new foundry technology center at the Fraunhofer IGCV.



CALA Delegation at the Fraunhofer IGCV, Photo: *utg*

### Our return visit to Shanghai

At the end of November, Wolfram Volk, Christoph Hartmann and Tianyou Liu set off on a week-long return visit to Shanghai. The week was filled with interesting encounters.

#### Tongji University

Tongji University can look back on a long Chinese-German history. Originally founded by Germans as a medical school, it is now one of the oldest and most renowned universities in China with an excellent engineering education.

Wolfram Volk was able to give an inspiring lecture to doctoral students of his colleague Junying MIN on the subject of material characterization. Afterwards, he and Christoph Hartmann met with representatives of the Chinese Society for Technology of Plasticity and discussed the NUMISHEET conference to be held in Munich in July.

#### Baosteel

Another highlight of the visit was the visit to Baosteel, one of the world's leading steel producers. Here we had intensive discussions about material characterization and were given an impressive tour of the world's largest

# utg News

hot-dip galvanizing plant. Particularly impressive was the fully automated “dark factory” facility, which offers an insight into the future of industrial production. We also visited the company-wide control center for digitalized processes, which uses state-of-the-art technology to monitor and control production processes.

## Jiatong University

Another interesting meeting with academic colleagues in forming technology was on the agenda at Jiatong University. Here, Wolfram Volk gave a foundry lecture to Master’s students. This was followed by a tour of the new research building, which impressed with its state-of-the-art equipment and innovative research facilities.

## ZwickRoell Taicang

On the last day of his stay, Wolfram Volk was able to visit the ZwickRoell branch in Taicang and take part in the first Testing Forum there. His presentation, which focused on the possibilities and limitations of materials testing, was again met with great interest and led to lively discussions.

**The visit to Shanghai not only strengthened existing partnerships, but also established new contacts and initiated future projects. We look forward to continuing this fruitful collaboration!**



*A warm Welcome awaited us at the Tongji University, Photo: utg*

## Open House Day



*Great interest from young and old for the casting demonstration, Photo: utg*

We were really overwhelmed. We hadn't expected so many visitors, young and old, on October 3. Over 80 institutions across the entire research campus opened their doors to more than 20,000 interested visitors. We also offered an insight into all areas of research at utg.

Our foundrymen Christoph and Simon showed how red-hot molten bronze is cast.

Visitors were able to experience the production of large sheet metal components for car doors, for example, on the hydraulic 350t press. Tianyou, Edgar and Thomas demonstrated how easily cracks can occur in the sheet metal components during forming. A material test on our tensile testing system clearly showed the maximum load that metal sheets can withstand.

Our colleagues Bastian and Philipp demonstrated how a mechanical high-speed press works and the research we are conducting here for the production of electric motors.

At utg, an average of 70 people took part in each of the four guided tours on offer.

It was a great day! We would like to thank everyone who enthusiastically made production technology research accessible to a wide audience.

# utg News

## Institute retreat at the Ammersee

At the end of July, our entire team met for the annual chair retreat, this time again at the Haus der Bayerischen Landwirtschaft in Herrsching. In inspiring surroundings, we took the opportunity to deal intensively with current and future topics.

The first day was dedicated to internal workshops. In small groups, we discussed ongoing projects, optimized internal processes and developed strategies for upcoming challenges. The open atmosphere allowed everyone to contribute their ideas and led to productive results that will further strengthen our collaboration. One highlight was the evening activities with various small competitions.

Our external doctoral students were also present on the second day. This began with an exciting **guest lecture** by **Dr. Reinhard Stolle** from Fraunhofer IKS on the topic of **artificial intelligence**. He gave us valuable insights into the topic. Inspired by these impulses, we then devoted ourselves in workshops to the question of how we can meaningfully integrate AI into our own work. The discussions were extremely enriching and opened up new perspectives for future projects.

**The results of the retreat will make a significant contribution to actively shaping the future of our department and forging innovative paths. We look forward to putting the knowledge gained into practice!**



Photo: utg

## Our new Bruderer press

Since November, a new BSAT 1600-181 has been added to our institute's machinery and equipment.



Press deliveries are always a logistical challenge, Photo: utg

The machine reached us directly after its manufacture and assembly in Switzerland and impresses here on site with an adjustment stroke of 19 - 100 mm, stroke rates of up to 600 strokes/min and a nominal force of 1600kN.

Research projects that are currently being investigated on the automatic punching press include strategies to reduce wear by influencing the thermal current, investigations into high-speed shearing and the characterization of forming machines in the course of dynamic measurement of high-speed presses.

**Many thanks to our long-standing partners Bruderer AG Switzerland and Bruderer GmbH Dortmund.**

# utg News

## New Member in the chair management team

Benedikt Kircebner will become part of the chair management team at the start of the new year, supporting Wolfram Volk and Christoph Hartmann.



Photo: utg

Benedikt Kircebner has been a research associate at *utg* since 2019 and conducts research in the field of droplet-based additive processing of metals using Molten Metal Jetting (MMJ).

In addition to his research activities, he is also involved in university didactics. In his new role, next to further driving the MMJ research, his responsibilities are coordinating the teaching at *utg* and further developing the teaching concept.

Benedikt Kircebner's involvement in the management team is an important step for us in order to master future challenges in the field of university teaching and to further improve the quality of teaching.

**We are looking forward to working together and are excited about the new impulses.**

## Barbara conference again very popular

For the third time, Casting Technology Munich hosted the Barbara Conference at the Fraunhofer IGCV in Garching. Following the tried and tested recipe, the event

offered plenty of variety with exciting presentations, the research marketplace and the cozy foundry evening.

The theme of this year's conference was "Technology trends in foundry technology". Of course, Think Big in Giga-Casting was the main topic of discussion. But printed sand moulds in new dimensions and future digitalization in the foundry world were also interesting presentation topics.

At the research marketplace, in addition to the projects of *utg* and Fraunhofer IGCV, four start-ups were also able to present their ideas to the experts and talk to them.

Traditionally, the foundrymen's evening with good food and draught beer brought the event to a successful close.

**We would like to thank everyone involved, especially the VDG and Fill Ges.m.b.H. for the food and drink!**



The hosts together with the speakers:  
from left: **Wolfram Volk** (*utg*), **Edmundo Filho Ferreira de Oliveira** (FILL Ges.m.b.H.), **Ingo Ederer** (Voxeljet AG), **Stefan Kneer** (Albert Handtmann Maschinenfabrik GmbH & Co.KG), **Steffen Klan** (Fraunhofer IGCV)

Photo: FraunhoferIGCV

# Current Research at *utg*

## Casting

### Inorganically bonded sand cores for die casting

Sand cores offer the possibility of creating cavities in cast parts. However, lost cores are not yet widely used in die casting. Therefore, the focus of the current research project is on the production of multi-layer sand cores that can withstand the high mechanical and thermal stresses of die casting on the one hand and ensure mechanical decoring on the other. The two-layer structure makes it possible to adjust the two sand-binder systems to these objectives. In addition, these sand cores can be equipped with sensors to measure the mechanical stresses in the casting process.

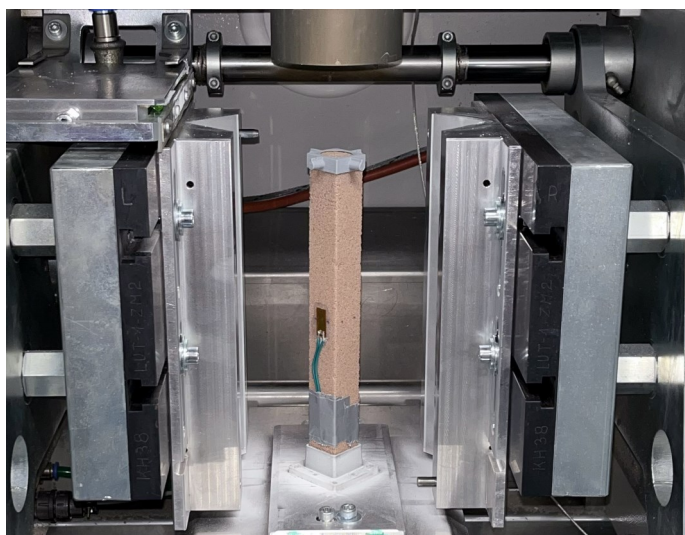


Figure 1: Two-stage core shooting process - inner core with applied strain gages, Photo: *utg*

#### Production of the multi-layer core

The cores are manufactured in a two-stage core shooting process (see Fig. 1). In the first step, the inner core is produced, to which two strain gages are then applied - one on the tension side and one on the compression side. To protect the cables of the strain gauges from damage in the tool, a hole is drilled in the underside of

the inner core through which the cables are routed to the outside. The instrumented inner core is then inserted into a second core shooter tool and enclosed with an outer layer. This outer layer has a higher binder content and is therefore high-strength.

#### Measuring the strain in the casting process

By measuring the sand core strain during the casting process, it is possible to draw conclusions about the mechanical load. Simulation results can thus be validated. The results help to better understand the material properties of the sand-binder systems used and to gradually bring the simulations closer to reality.

#### Proof-of-concept test stand

A proof-of-concept test rig was developed for this year's Barbara Conference at the Fraunhofer IGCV (see Figure 2). This simulates a three-point bending test with two-layer bending bars (420 mm x 420 mm x 220 mm). The two strain gauges applied to the inner core were connected to form a half-bridge. If a weight is now placed on the bending beam, the test stand displays the weight and the equivalent bending strength. The signals are processed by a microcontroller.

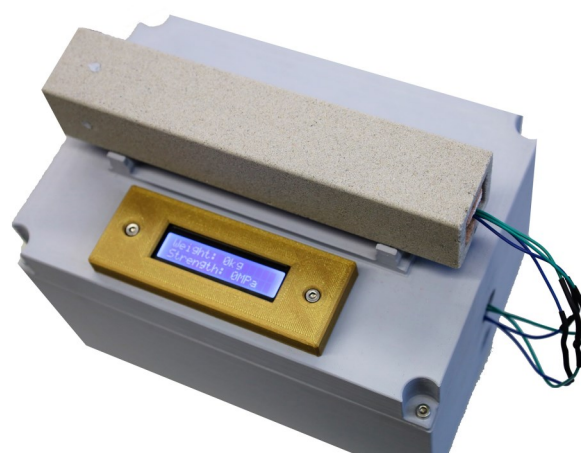


Figure 2: Bending test of a sand core fitted with strain gages, Photo: *utg*

**Contact:** Erwin Reberger, M.Sc.

# Current Research at *utg*

## Cutting and Blanking Technology

Toothing with better load-bearing capacity thanks to fine blanking



Fig. 1: Precision-cut components from the DFG priority program SPP 2013

### Motivation

Near-net-shape blanking processes (NNSB) are one way of economically producing functional surfaces on metallic components. However, separation processes are generally associated with large plastic deformation and therefore generate residual stresses in the component.

In a previous research project [1], various NNSB processes have already been investigated for their ability to reproducibly set residual stress states in precision-cut components. By modifying the manufacturing strategy, it was possible to find process parameters with which process-induced residual compressive stresses can be specifically set. The results show a significant improvement in component service life with high geometric accuracy.

For the production of functional surfaces on gears, a great potential for savings in terms of cost, time and energy consumption compared to conventional machining production was uncovered.

### Goal

The current research project is now focusing on the development of a fine blanking process that is suitable for the industrial environment for the production of series gearing. We expect the new process to result in increased load-bearing capacity due to process-induced resi-

idual compressive stresses. Through strategic cooperation with industrial partners from the field of fine blanking technology and drive technology, the commercially usable process should be qualified to produce applicable stepped gears by precision cutting.

The focus is on high process reliability and comparatively inexpensive tools as well as low noise and vibration excitation of the stepped gears.

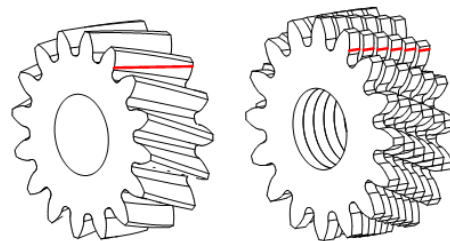


Fig. 2: Approximation of helical gearing using stepped toothing

Another focus of the research project is the analysis of product and process variables. In addition to the cutting surface parameters and geometric accuracy, the component service life and component load-bearing capacities and how they can be influenced by process variables are also being investigated.

### Outlook

The process design and feasibility analysis have already been successfully completed and the new test tool is operational. The work on numerical process modeling and sample production is now pending.

The knowledge gained will be used to develop standard proposals and standards for the manufacture and load capacity calculation of fine-cut stepped helical gears. The DFG project 531865360 is scheduled to run for two years and is expected to end in 2026.

**Contact:** Anian Nürnberger, M.Sc.

[1] DFG-Project 374524261: Characterization and use of process-induced residual stresses in the production of functional surfaces by near-net-shape blanking processes (2017-2024) from the priority program 2013



# Current Research at *utg*

## Forming Technology

### Simplified IHU process for the production of large hydrogen pressure vessels

In our last newsletter, we reported on our research into the production of large hydrogen pressure vessels. Following the investigations into material behaviour, we will now take a closer look at the actual production process.

#### Initial situation and objectives

Normal tanks cannot be used to store hydrogen, which is why the *utg* is conducting research with various industrial partners into the development of hydrogen-specific pressure tanks. The focus is on large-volume pressure tanks based on the concept of lightweight construction and designed to withstand additional requirements such as low permeability and low hydrogen reactivity.

#### Manufacturing process

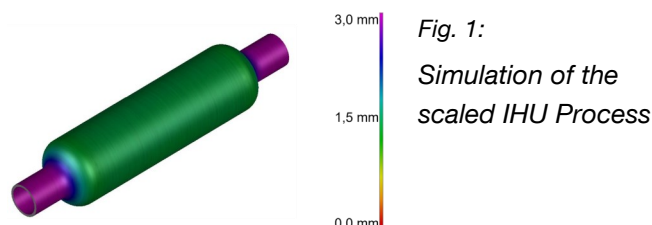
Hydroforming offers several advantages over the incremental processes that are currently frequently used. By expanding the tubes in the hydroforming process, this process can start from a smaller tube diameter, which saves time and resources. This development is supported by the simulative mapping of this production route as well as by experimental investigations.

#### Simplified hydroforming process

What is special about the concept of the hydroforming process at *utg* is that the forming takes place without servo-hydraulic axes, which are otherwise used in a conventional hydroforming process. This simplifies the process to such an extent that forming can be carried out on many simple hydraulic presses. This eliminates the need for the cost-intensive purchase of specially developed hydroforming systems.

However, the degree of freedom of repressing is not available here, which means that only a lower forming capacity is possible with this process. The forming

steps with the reduced forming capacity were simulated and are validated on a scaled basis at the chair.



The experimental implementation is carried out on the hydraulic 350t Dieffenbacher press, as this can apply the required forces.

For this purpose, a new modular tool was designed in which the various forming dies can be installed. The forming force is generated by a pressure intensifier provided by Schnupp Hydraulic.

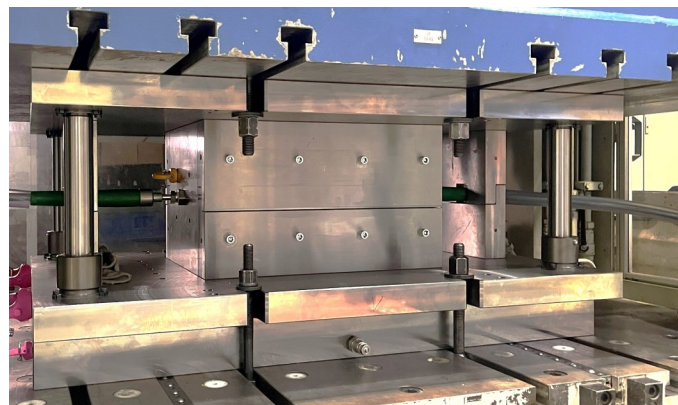


Fig. 2: Built-in hydroforming tool, Photo: *utg*

#### Outlook

This test is intended to confirm the simulation results and achieve the highest possible formability of the aluminium tubes used. In addition to investigating the forming capacity, the structural changes and material characteristics after forming will be examined in more detail.

These investigations should help to ensure a stable process sequence and to develop a suitable aluminium container for hydrogen storage.

**Contact:** Thomas Spörer, M.Sc.

## Awards at *utg*

### Lorenz Maier wins EFB award

We are delighted that Lorenz Maier has been awarded the EFB Project Prize 2024.

The award-winning research work focuses on the development of a **tryout manager for sheet metal forming**. By using this methodology, the training time in toolmaking is shorter and therefore more efficient.

The integration of simulation data, the use of a mathematical surface description using B-spline surfaces and the systematic analysis of deviations in deterministic and stochastic distributions are central aspects of the project. The required data volumes are so small that statistical analyses can be carried out without having to rely on extensive computing times.

The Tryout Manager is therefore particularly suitable for use in small and medium-sized companies.

#### The results were published in EFB Research Report No. 602.

Lorenz Maier is part of the forming group at the *utg*, where he conducts special research into material characterization and modelling.

The award was presented to him during the EFB's 75th anniversary celebrations in Würzburg in April.

**Congratulations!**



Foto: EFB

## Events at *utg*



### Stamping technology in Dortmund

As usual, the 15th edition of the leading trade and networking event for the stamping and forming industry will once again take place at the Westfalenhallen Congress Center in Dortmund.

In 2025, the **two-day program** will revolve around two main topics:

- **Tools** - our path to economic success
- Intelligent and innovative **quality assurance**

With specialist presentations by experts from industry and research.

Two non-specialist keynote speeches followed by a panel discussion on the key topic of **“Social media - customer acquisition and retention as well as recruiting”** will provide a look at the bigger picture.

The congress will be accompanied by a trade exhibition of over 30 well-known companies from the industry.

Further information on the agenda, participation fees and registration can be found on the website

[www.kongress-stanztechnik.de](http://www.kongress-stanztechnik.de)

The conference language is german.

This year, the Dortmund event agency STRATEGIEX is organizing the renowned stamping congress for the first time.

## Events at *utg*



The 13th International Conference and Workshop on Numerical Simulation of 3D Sheet Metal Forming Processes takes place in Munich, July 7-11, 2025

It will once again be an international platform to discuss new ideas, strengthen existing relationships and establish new collaborations with leading researchers and industrial companies.

The **NUMISHEET 2025** will focus on key advancements in manufacturing and materials science.

What are the **main topics**?

- Data-driven approaches
- Material testing and modelling
- Process simulation and springback
- Tooling and tribology
- Inline measurement and process control

NUMISHEET 2025 offers a total of around 170 presentations, seven highly interesting keynotes and two benchmark workshops as well as several exciting company tours.

**Where?** Leonardo Royal Hotel, Munich

**When?** July 7 to 11, 2025

Registration will open soon: <https://numisheet2025.com/registration/>

Find out more about this unique event: [www.numisheet2025.com](http://www.numisheet2025.com)

Thanks to our main sponsor:



# Personnel at *utg*

We extend a warm welcome to:

We wish all the best for the future:



**Tarek Azzouni, M.Sc.**  
joined the forming group on 1 December 2024.



**Dr.-Ing. Roman Norz** left the *utg*  
on July 14, 2024.



**Alexander Bissinger, M.Sc.**  
joined the casting group at *utg* on  
1 December 2024.



**Lorenzo Scandola, M.Sc.** left the  
*utg* on November 30, 2024.



**Lysimachi Iona, M.Sc.**  
joined the cutting and stamping  
group on 1 December 2024.

# New Dissertations at *utg*

- 50 **Werner, Matthias Konrad:** Freiformbiegen von rechteckigen Hohlprofilen, September 2024
- 51 **Deng, Fangtian:** Exploring the Impact of Mold Coating Thickness on Thin-Walled Castings Quality and Developing In-Line Monitoring Solution, Oktober 2024
- 52 **Vitzthum, Isabella Marie Franziska (geb. Pätzold):** Adapting two-stage shear cutting process parameters to the component geometry to increase process reliability, Oktober 2024
- 53 **Baitiang, Chinnadit:** Methodology for Creation of Control Loops for Vertical Molding Foundry with the Aid of Big Data Approaches, Dezember 2024

All publications and dissertations of the chair are listed on the website [www.mec.ed.tum.de/utg](http://www.mec.ed.tum.de/utg)

The dissertations appear printed in the **series *Metal Forming and Casting***, ed. Prof. Dr.-Ing. W. Volk, Kollemosch Verlag & Kommunikation, ISSN: 2364-6942

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