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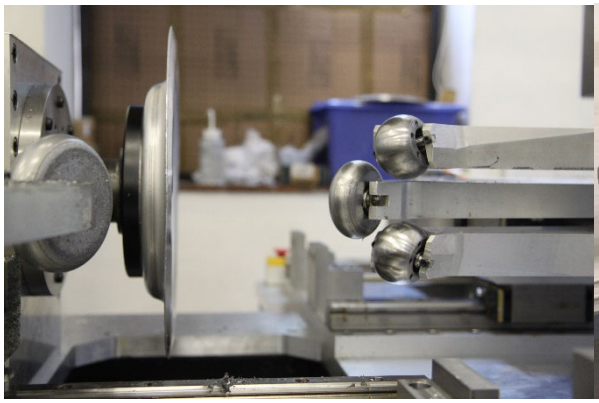
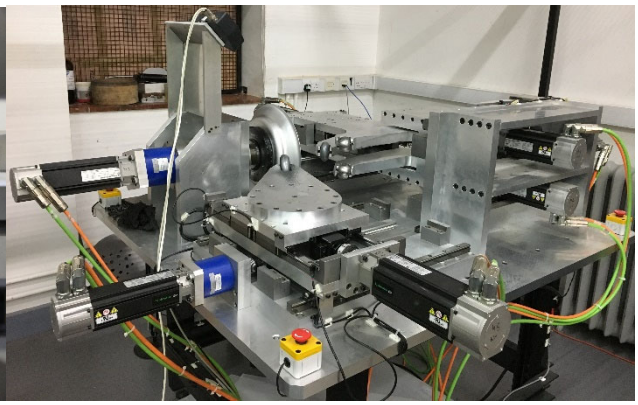
/ Where ideas thrive

Flexible Mandrel-Free Spinning

Controlled die-less metal spinning with optional asymmetry

Case Ref: All-2449-10





Laboratory scale development machine at Cambridge

Step change productivity in spinning: no mandrel, geometry control, asymmetry

Metal spinning is used to manufacture high-value parts to near-net shape in low volumes and with high precision. However, until now, each new part needs a dedicated mandrel driving **cost and delay** which is increased by the time required for tool-path design. Further, most spinning equipment is limited to axially **symmetric** parts.

A University of Cambridge research team, in partnership with supply chain stakeholders, has delivered a step change in the productivity of metal spinning. Their new process demonstrates the ability to produce spun parts **without mandrels,** a wider range of product geometries including **re-entrant shapes**, **closed-loop feedback control** based on product geometry and tool-force sensing, and production of **asymmetric parts.**

New machine features (see diagram overleaf)	Technical benefits	Market benefits
1. **Computer controlled internal rolls** to replace the mandrel (top left photo) 2. **Sensing** of part geometry and tool forces 3. **Co-ordinated pulsing** of tools to allow production of asymmetric parts.	• Removes the need for a dedicated mandrel • Wider range of product geometries, including re-entrant shapes • Enables tool-path design and control based on both geometry and force feedback • Allows asymmetric (non-axisymmetric) part production	✓ Significant reduction in **set-up and switchover time** ✓ Eliminates **mandrel** costs ✓ More **rapid product introduction** ✓ **New part geometries** with asymmetry

Target market

This technology is aimed at **spinning companies** in the supply chain for a wide range of high-value components, for applications in aerospace, automotive, medical and industrial equipment

Spun parts are typically used in jet engines and turbines, radar reflectors and satellite nose cones. Producing parts with this process widens the range of applications to the production of asymmetric parts (such as the front cowlings of jet engines) and contributes to the sustainability and resource efficiency of the process.

Further information

Please view second page for further information including the stage of development and implementation of this technology.

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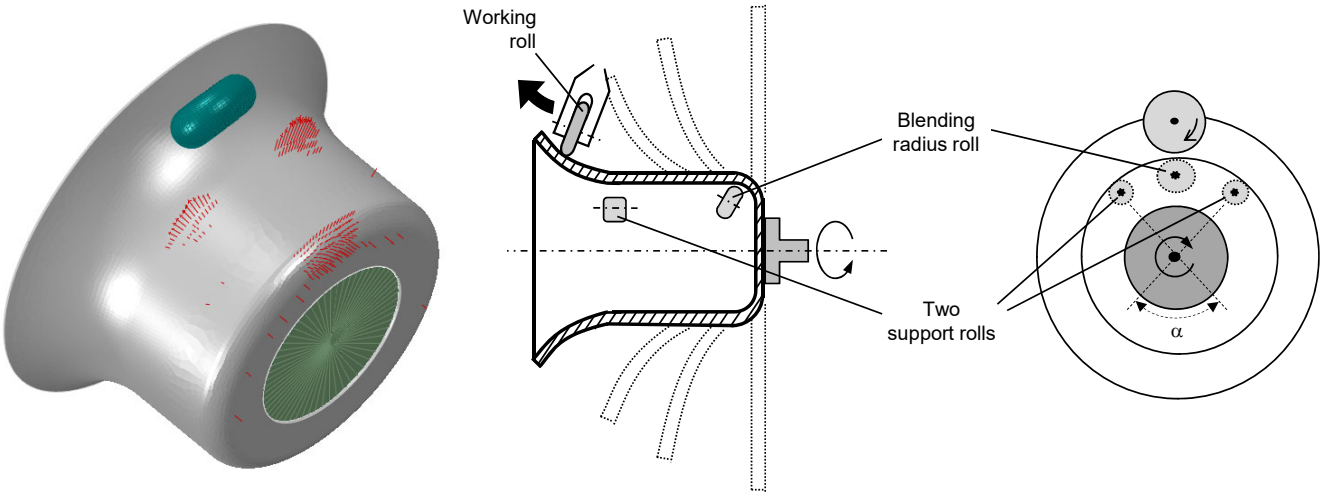

The principle of the new process: on the left, the contact between mandrel and workpiece in conventional spinning – restricted to three clear zones; diagrams centre and right show the three controllable rollers in the new process that re-create this contact without needing a mandrel.

Stage of development

The inventors, advised by an industrial consortium spanning users, spinning companies and control system suppliers, developed the flexible mandrel-free spinning concept and laboratory scale **machine capable of spinning a range of metals up to 1m diameter**. An industrial-scale machine has since been developed at the Manufacturing Technology Centre Catapult in Anstey.

Extensive work on tool-path design, from optimisation based on finite element simulations to comprehensive studies with craftsmen operating the machine via a haptic interface have led us to a firm basis for developing generic tool-path design and control. Next steps are to work with machine builders and users on pilot production.

*The industrial development machine at the Manufacturing Technology Centre Catapult: **process proven** at scale*

Implementation

The new process could be implemented as a retrofit to an existing spinning machine, or the complete package can be delivered as a standalone project. New control software and ongoing customer support offer further revenue streams for the machine supplier.

The inventors

Dr Omer Music

Prior to his PhD on Flexible Spinning, Dr Omer Music worked in the manufacturing industry for six years. He has since been working on industrial and academic research projects in metal forming.

Professor Julian Allwood FREng

Professor Julian Allwood has a longstanding interest in novel flexible metal forming processes. He heads the Use Less research group at Cambridge, pursuing world leading research into the sustainable use of materials, energy and resources.

Commercialisation

This technology is protected by granted US, EU and JP patents (International patent WO2012042221A1)

We are looking to partner with an equipment manufacturer to further develop and commercialise this technology