Production Technologies & Equipment for Micro-Manufacturing

# **Catalogue of Technologies**

## developed inside the Integ-Micro Project



Our platforms are hybrid, reconfigurable, multitasking machines integrating different high precision techniques for the generation of 3D complex shape micro-components.

Combining several machining technologies into one single machine allows important synergies between the different machining methods so, with these platforms, you can achieve greater accuracy, performances, have less handling and a reduced plant area. In summary, you can have increased productivity adapting your company to current and future economic challenges, and the increased competitiveness.

Definitely, the innovation of the European micro-precision industry starts from here.







PLATFORM 1A multitasking cnc "machining centre ecµ"

FOR LASER ASSISTED ULTRA HIGH SPEED

MICROMILL-TURNING



PLATFORM 1B

COMBINED MICRO MILLING AND LASER STRUCTURING



PLATFORM 2

MICRO EDM COMBINED WITH DRILLING / MILLING /

GRINDING

PLATFORM 3

ULTRASONIC VIBRATION ASSISTED MICRO MILLING /

**DRILLING / GRINDING** 



PLATFORM 4 µ4™ ULTRA PRECISION COMPACT 5 AXIS DIAMOND MICRO-MACHINING

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# **PLATFORM 1A**

## MULTITASKING CNC "MACHINING CENTRE ECµ" FOR LASER ASSISTED ULTRA HIGH SPEED MICROMILL-TURNING

A multi-process machine which enables ultra high precision and efficient micromachining of 3d complex shape parts through the integration of ultra high speed micro mill-turning and laser-assisted machining in the same setup.



#### FIDIA nC15 data

CPU: 1.8 GHz Operating system: Windows XP Monitor: 15" TFT touch screen Number of interpolated axes: 8 axes plus 1 spindle Graphical support: ISO machining cycles Connection: FIDIA Fast Field Bus (FFB)

Laser device specifications

Source Diode direct laser Average Power [W] 300 Wavelength [nm] 915 Beam carrier Fiber optic high power

# High Speed and Precision bi-rotary Table for Micro Mill-Turning specifications

Table diameter: [mm] 150 Table height: (H position) [mm] 250 Payload: [Kg] 10 Turning (C) and tilting (B) axis features: Speed: [rpm] (C) 4'000 (B) 50 Drive torque: [Nm] (C) 18 (B) 48 Repeatability: (C, B) 2" Min. increment: (C, B) 0,02"





#### **Main Technical Features**

#### **Chassis materials**

- X-Y axes structures: Electro-welded Steel filled with Ultra-Light HYDROPOL®
- Z axis structure: Cast Iron
- Bed: Synthetic granite

#### Strokes

• X/Y/Z: 300/250/300 mm

#### Feed rate

• X/Y/Z: 20 m/min

#### Acceleration

- X/Y/Z: 4 m/s<sup>2</sup>
- Repeatability
- <±1 [µm]
- Electrospindle speed
- 40'000 rpm
   Electrospindle power

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• 7'000 W

What you can do with Platform 1a	<ul> <li>applications requiring roughness Ra &lt; 0,1 µm</li> <li>machining of hardened steel (&gt; 55 HRC) and titanium</li> <li>reduce the process chain as a whole, the throughput time and increase the production rate</li> </ul>	
How to make your prototypes	CONTACT: Eng. Monica Lucassino Tel +39 (0) 50 883005 Email: m.lucassino@sssup.it CERFITT, Integ-Micro Facility Lab. Viale Rinaldo Piaggio 34, Pontedera (PI) - ITALY	

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# **PLATFORM 1B**

#### COMBINED MICRO MILLING AND LASER STRUCTURING

Platform 1b integrates a machine tool system for combined process of micro milling and laser ablation. The system is programmable through an adapted CAx platform. A novel force measurement system provides high reliability for micro milling operations.

#### **KERN EVO**

Strokes:	linear
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• X: 300 mm

axis

- Y: 280 mm
- Z: 250 mm

#### Clamping

area:	max. 350 x 230 mm <sup>2</sup>
system:	System 3R Macro

#### Rotational axis

- Swivelling: (A, B) -20° up to 110°
- Rotational: (C)
  Acceleration:
  Precision :

<sup>2</sup> Space Requirements: Weight approx. -20° up to 110° 360° continuous 10 m/s<sup>2</sup> < 1<sup>"</sup> min 2.85x3.58x3.14 m<sup>3</sup> 8000 kg



laser ablation module

KERN Evo, a five-axis ultra-precision machining centre, is suited for medium to large production lot sizes. The system has been equipped with a laser ablation module, developed by Fraunhofer IPT and Kern Micro-und Feinwerktechnik GmbH & Co. KG.

## FORCE MEASUREMENT SYSTEM FOR MICRO MILLING



Developed by WZL/RWTH and KISTLER



#### **KERN PyramidNano**



COMBINED MICRO MILLING AND LASER STRUCTURING

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## PLATFORM 2

#### MICRO EDM COMBINED WITH DRILLING / MILLING / GRINDING

Platform 2 combines electro-discharge machining (EDM) with micro drilling, milling and grinding in order to address a wider material range. Newly developed process monitoring sensors and applications help to achieve a higher standard in precision and surface quality. This platform enables machining using classical cutting processes like milling, drilling and grinding as well as the use of micro-EDM processes.

The machining platform focuses on the reduction of main operation time, on the increase of the automation level and range of materials that can be machined as well as on the achievement of higher precision and surface quality. By combining technologies, unnecessary tool changes no longer need to be made, therefore preventing alignment errors which amount to costly production downtime.



#### Milling / Grinding Spindle (Westwind)

- Speed Range: max 160000 rpm
- Drill Size Range: 3 mm collet
- Max. axial Load: 18.5 Kgf
- Electrical contacting with cutting tool is possible

#### **EDM spindle:**

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High precision indexed Rotation spindle with internal flushing

- Automatic feeding of electrode to avoid
   manual interaction
- Repetition precision:  $\leq 0.05^{\circ}$
- Runout precision:  $\leq \pm 1 \ \mu m$
- Rotation speed: ≥ 800 U/min

#### **Electrode Dressing Unit:**

- Automatic Electrode dressing unit (Wire-EDM system for wire electrode with 0.2 mm in diameter)
- Electrode measuring with Laser-, Measuring- and Electrode-identification
   system
  - Resolution from measuring unit: ≤ 0.01 μm
  - Smallest measuring object: ~ 5 µm
  - Electrode cleaning system

#### **Positioning:**

- **X/Y/Z** in mm: ≥ 320/200/200
- Resolution: 0.1 µm
- Positioning precision:  $\leq 2 \ \mu m$

# Process control and Design of Working Technologies:

- Free access to the Generator parameters
- External Process control through analogue and digital ports (>10 Analog / Digital-Input / Outputs)

# CNC Device with two indexed workpiece rotation axes:

- Rotations axis 1 (A): 0-90°
- Rotations axis 2 (B): 0-360°
- Resolution: 0.01°

#### **EDM Generator:**

- Discharge current: from 0.5 A to 60 A
- Voltage: 60 V to 150 V
- Discharge time: 30 ns up to 10 µs
- Surface quality: Ra  $\leq$  0.1  $\mu$ m



#### Dielectric system:

Oil based Dielectric and Water **Usage** as tank or local flushing

High pressure flushing:
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≥ 70 bar





# AICRO EDM COMBINED WITH DRILLING / MILLING / GRINDING

## PLATFORM 3 ULTRASONIC VIBRATION ASSISTED MICRO MILLING /

#### **DRILLING / GRINDING**

The combination of several chip removal processes and ultrasonic vibrations shows many potential advantages for applications like the manufacturing of tooling for replication processes. Such integration of technologies, with the assistance of ultrasonic vibrations and active magnetic bearings, creates a manufacturing system both with improved capabilities and with the ability to process materials impossible for current existing micro milling / grinding / drilling systems.



#### Spindle specifications

- Rotation Speed: >
  - > 100000 RPM •

> 0.09 N-m

 $< 1 \mu m$ 

• Torque:

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- Axial Stiffness: > 24 N/µm
- Radial Stiffness: > 29 N/µm
- Runout:
- Spindle diameter: < 100 mm
- Vibration amplitude: < 2 µm
- Vibration frequency: 0.1~2 kHz
- Stability: < 0.1 N

• Mass:

< 3 kg

< 350 mm

- Spindle length:
- Avoid actuation at the natural frequencies of the shaft
- Shaft assembly by hooping
- Axial vibration frequency: 1 kHz
- Axial vibration amplitude: 1µm
- Maximum control delay: 15-20°



Ultrasonically assisted Machining (UAM), is an innovative technology in which a high frequency vibration (~20kHz) with an amplitude of some micrometers (5~15  $\mu$ m) is applied to the continuous movement of the tool. The supplied power reaches values of 50 to 3000 W.

What you can do with Platform 3	<ul> <li>assemble the spindle in any platform</li> <li>put the spindle in parallel with the machining spindle to produce more processes in the same machine</li> <li>work polymers, ceramics and hardened steel</li> </ul>
How to make your prototypes	<u>CONTACT</u> : Eng. Monica Lucassino Tel +39 (0) 50 883005 Email: m.lucassino@sssup.it CERFITT, Integ-Micro Facility Lab. Viale Rinaldo Piaggio 34, Pontedera (PI) - ITALY

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## **PLATFORM 4**

#### µ4™ ULTRA PRECISION COMPACT 5 AXIS DIAMOND MICROMACHINING

Platform 4 incorporates ultra precision diamond and CBN cutting processes, including turning, drilling, milling and micro abrasive machining. The machine is developed to minimize tooling and component handling whilst easing in-situ metrology, error correction and thereby enabling cost effective fabrication of ultra precision complex shape components.



#### **PLATFORM 4 specifications**

- Footprint 0,546 m<sup>2</sup>
- Excellent **surface finishing** (Ra ~1nm)
- Sub-micron size/ form accuracy
- 1nm resolution linear and rotary motions
- Integration of different platforms with precise handling
- Adaptive fixture for **self-aligning** and **micro-positioning**

- Eco-friendliness and energy saving
- New nano-structured tool coatings
- Advanced materials
- New high frequency dynamometers
- **Spindles speed** up to 330.000 rpm with dry machining
- CAPP Computer aided process planning

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A / C axes sub-system



Automatic tool change sub-system with optical tool setting system

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What you can do with Platform 4	<ul> <li>work brass, stainless steel and titanium as well as very fragile materials</li> <li>impart a very high quality "reflective" surface finish (jewel-like appearance)</li> </ul>
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# THE INTEG-MICRO DEMONSTRATION FACTORY



It will be possible to see the Integ-Micro platforms at the co-located demonstration facility that will be arranged at The BioRobotics Institute of the Scuola Superiore Sant'Anna where it will be also possible to test these innovative machines and attend seminars and technical courses.



contract no. CP-IP 214013-2



#### For more information...

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