



NEWSLETTER

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Intelligent Control of Interconnected Manufacturing Infrastructures (i-CNC)

Developed under the Trials Net Open Call

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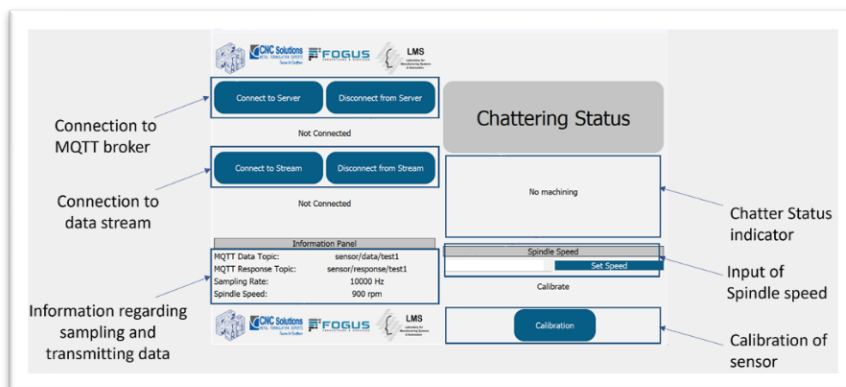
The TrialsNet project has received funding from the European Union's Horizon-JU-SNS-2022 Research and Innovation Programme under Grant Agreement No. 101095871.



SECTION 1: I-CNC USE CASE RESULTS

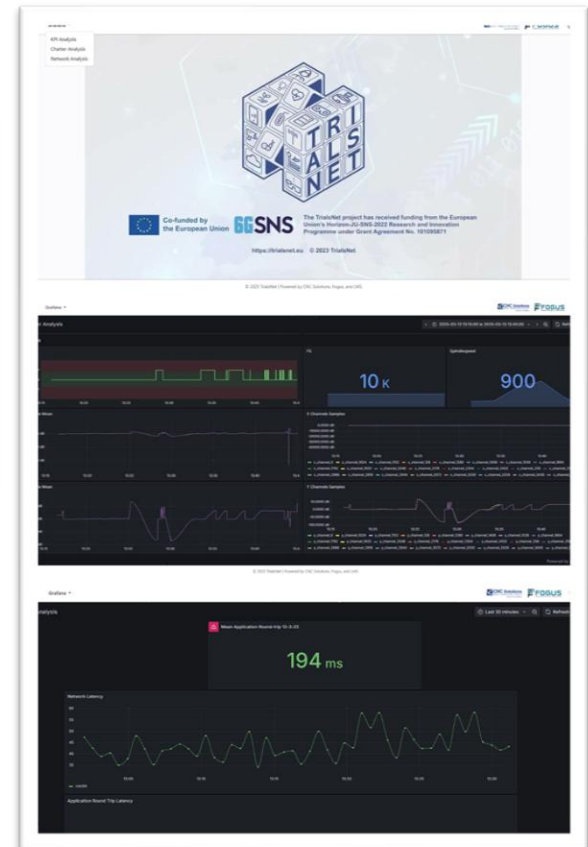
The results of the i-CNC project can be categorized into technical and societal impacts. From a technical perspective, a successful end-to-end communication process was achieved, linking the CNC machine with the AI assessment module via a 5G network. During the trial event—a live demonstration of this process, described in the following section—a CNC operator completed a milling task with the support of the i-CNC solution, providing real-time alerts on chatter presence through a nearby monitor. The alerts assisted the operator to decide when to interfere with or stop the milling process to avoid wasting raw materials. The operation was conducted through a user-friendly GUI. A separate dashboard was created to monitor and present key performance indicators (KPIs), along with valuable metrics related to the application and network conditions.

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From a societal perspective, the i-CNC project seeks to make a meaningful impact on both human life and the environment. In CNC machining, chatter leads to suboptimal milling, which compromises product quality and results in unnecessary material and energy waste. The AI algorithm integrated achieves accuracy above 95% and precision above 90% in detecting chatter, enabling the operator to halt operations before significant resources are wasted. Early detection also reduces material loss by preventing defective cuts, thereby contributing to more efficient and sustainable manufacturing.

From an economic perspective, the AI algorithm combined with 5G connectivity makes sure that there is instant communication between the CNC machine and the AI model, allowing for instant corrective actions. This capability reduces machine inefficiencies and downtime, thus reducing operational expenses by 4% - 6% per machine. Also, since chatter leads to defective workpieces that are scrapped, it results in wasted raw materials. By detecting



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chatter early with over 95% accuracy, i-CNC reduces up to 90% of material waste caused by chatter, significantly improving resource efficiency. Another economic sustainability factor is 5G connectivity, which provides the adequate infrastructure for real-time processing by AI and immediate response to the identification of chatter. The system possesses low network round-trip latency (50 – 100 ms) and application round-trip latency (150 ms) such that the CNC machines are provided with timely commands to continue working or stop working.

Another key benefit of the i-CNC use case is the simplification of CNC machining operations. The process of detecting chatter manually can be mentally overwhelming for operators, since it requires continuously overseeing the machine's performance. By integrating an AI-based algorithm, CNC operations become more straightforward, reducing the need for constant human intervention. Real-time monitoring further enhances ease of use, allowing operators to remotely observe the process and focus on other priority tasks.

SECTION 2: TRIAL EVENT: FROM PRESENTATIONS TO LIVE DEMONSTRATION

The i-CNC Trial event took place on March 13th in Paiania Greece where CNC Solutions provided both facilities and technical expertise, ensuring that the trial execution was based on real-world manufacturing challenges. The event was attended by 30 participants representing a diverse range of stakeholders. Multiple academic institutes participated through their representatives, contributing in creating a connection within theoretical research and practical application. The academic representation included PhD candidates, professors and undergraduate students. Furthermore, in the event attended CNC operators and industry representatives, ensuring broad representation across knowledge levels and industry involvement. Participants had the opportunity to see in real time the i-CNC solution in operation and understand its real-life applicability. The event consisted of a theoretical part and a live demonstration of the i-CNC system on both locations of the project. The primary site at CNC Solutions in Paiania, which is a fully equipped machine shop with latest technology machines, and the facilities in Patras connected via real-time video link and data



Intelligent Control of Interconnected Manufacturing Infrastructures (i-CNC) / Issue 2 / Oct. 2024 – April 2025 sharing capabilities in the context of the presentation. The two sites demonstrated the capability of the system to monitor in real time and analyse data across geographically distributed manufacturing facilities.

The event began with introductory presentations designed to familiarize the audience with CNC, 5G networks, AI in Industry 4.0, and the i-CNC use case. A live connection was then established with the second site in Patras, where a presentation on the machine and its operation was given. After a group photo and engaging discussions, attendees proceeded to the machinery room for the live demonstration.

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Before the demonstration, a brief explanation was provided on the setup, which included the sensor installed in the CNC machine, the 5G router etc. The machine room had two screens: one for the operator to monitor system alerts and detect chatter phenomenon during milling, and the other displaying a customized dashboard with the key performance indicators (KPIs) of the actual milling process. After the demo, some technical and scientific questions were raised, including questions about the future of such endeavors.

A questionnaire was shared with participants at the event to collect feedback on its effectiveness and identify areas for improvement. Out of 30 participants, 22 responded with their questionnaire, which had 12 questions about their background, knowledge, experience, and overall impression. Most participants were PhD students or researchers. While most of them had prior knowledge of CNC, their knowledge of 5G networks was largely basic. Responds to AI awareness were split between basic and intermediate levels. Over half of the respondents recognized the importance of implementing advanced AI and 5G in industry. Many participants had attended similar events before, and their motivation of attending that event was either the relevance of the topic or its academic appeal. Comments about the event were extremely positive, with most attendees considering the content relevant, the presentations and demonstrations to be excellent in terms of clarity, and most of them saying that the event was better than expected. Some of the key takeaways from the i-CNC use case were the



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benefits of increased automation and reduced material wastage through elimination and anticipation of chatter.

In addition, a separate questionnaire was distributed to CNC machine operators with the goal of gathering insights on their i-CNC enhanced milling experience and the effectiveness of the AI and 5G components. The results of this questionnaire indicated that the operators' experience with the i-CNC solution was seamless and efficient. Also, the operators expressed that the i-CNC solution was important in assisting them managing the chatter phenomenon. Last but not least, the operators felt confident in using this solution in a real production environment. These results depict the quality of experience of the operators, which in this case are the end users and the ones who have to use daily this enhanced CNC machine with AI.

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SECTION 3: TAKEAWAYS & OPEN CALL EXPERIENCE

The i-CNC project connected three key sectors—industrial manufacturing, AI and smart systems, and 5G telecommunications, represented respectively by companies **CNC Solutions**, **Laboratory for Manufacturing Systems & Automation**, **University of Patras**, and **Fogus Innovations & Services**. The initial goal of the project was not only to bridge these domains, but also to generate meaningful outcomes through their collaboration.

Among the most interesting outcomes were:

- The industrial sector shows a growing demand for intelligent systems that reduce manual labor and incorporate predictive monitoring tools, which can ensure smoother production processes while supporting both environmental and economic sustainability.
- AI technologies have matured to a level where their safe and effective deployment in real industrial environments is possible. Having real-world data for model feedback enables these systems to evolve, improve, and get more accurate.
- 5G networks are becoming important to Industry 4.0. Their adoption in manufacturing environments not only enhances performance but also reveals new possibilities for optimization and helps define future network specifications tailored to industrial needs.

The TrialsNet open call experience was smooth, beneficial and really insightful about the current state of the three key sectors—manufacturing, AI, and telecommunications—within the Greek landscape. It highlighted some future needs such as the importance for more experts in CNC machining, the lasting improvement in data analysis and development of AI algorithms as well as the critical expansion of telecommunication infrastructure to support



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new generations in networks such as 5G. The project of i-CNC managed to achieve all the targets that had been set and fulfill its mission which was the control in an intelligent and interconnected manufacturing infrastructure using 5G networks, AI algorithms to detect the chatter phenomenon during CNC milling.

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