

COMPANY INFORMATION:

Company's name: RODEN Tool Manufacturing Plant Limited Liability Company

Company Registration Number : 30636971

Date of Registration: 06/12/1999

Size (number of employees): 32

Annual turnover (in millions of €): 0.667

REGISTERED COMPANY ADDRESS:

Street: Nevska str.,

Postcode: 03062

City: Kyiv

Country of registration: Ukraine

APPLICANT CONTACT DETAILS:

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ADDITIONAL**How did you learn about LASER-PRO?**

I learned about LASER-PRO through the Lithuanian Innovation Centre, which together with international partners implements the LASER-PRO project (<https://www.laserpro-eh.eu/>) and is responsible for the Mentoring Programme for Ukraine. The programme aims to support the Ukrainian laser ecosystem and to share EU knowledge and best practices. Information regarding participation in conferences and related opportunities was also received through Khrystyna Kozlovska (kristina.kozlovska.17@gmail.com).

PROPOSAL

Proposal full name: Laser Calibration Platform for Geophysical Instruments: Accelerometers, Velocimeters, and Displacement Sensors

Proposal acronym: LCP-GS (Laser Calibration Platform – Geophysical Sensors)

Summary: The proposed project involves the development of a laser calibration platform for geophysical sensors, including accelerometers, velocimeters, and laser displacement meters. The objective is to create a highly accurate automated system that uses laser measurements as a reference standard to improve the accuracy and repeatability of calibration. The innovation of the proposed solution lies in the integration of laser metrology with digital data processing and automated comparison of signals from different types of sensors. The project is expected to deliver a demonstration prototype capable of performing calibration under controlled laboratory conditions as well as in environments closely resembling industrial conditions, with an accuracy of up to 0.1%. The project is highly relevant for industry, as it addresses the limitations of existing calibration methods for geophysical measurement devices in terms of accuracy and versatility. This creates a market opportunity for the development of universal calibration solutions for scientific, industrial, and engineering applications. In the short term, the project is expected to produce a functional prototype and validate the technology. In the long term, the platform will be commercialized and its application expanded to infrastructure monitoring, geophysics, and high-precision measuring instruments developed in-house (<http://seismo.kiev.ua/Adv/BrhlDev/>, <https://lavra.igs-nas.org.ua/Adv/JAVASOFT/LaserSeismometerLTDxRODENx20251224x002A.pdf>, <https://lavra.igs-nas.org.ua/DOCS/ACCEL/index.html>). The development of an in-house laser calibration device will also enable the supply of affordable geophysical measurement systems to countries with limited financial resources, such as Laos, Cambodia, and other developing countries, thereby expanding access to modern measurement technologies. In the long term, the platform is intended to be commercialized and introduced into the field of governmental and industrial metrology in Ukraine for geophysical measurements, including through collaboration with leading national metrology institutions such as the State Enterprise "UKRMETRTESTSTANDARD."

Is this the first time that you submit your proposal? First submission

Have you read and understood the Application guidelines? YES **Have you read and understood the Service Delivery Agreement (SDA) template, and do you agree with its terms and conditions?** YES

Market sector your Pilot Case project refers to? Laser metrology and measurement technologies; geophysical measurement systems; industrial sensing and calibration technologies; laser metrology research instrumentation.

Have you received any support in proposal preparation from the LASER-PRO consortium? NO

CONCEPT

Challenges that need to be overcome: As part of previous research and development efforts, a prototype laser calibration device for geophysical sensors has been developed, demonstrating the feasibility of the fundamental principles of laser metrology for calibrating accelerometers, velocimeters, and laser displacement sensors. The current challenge is to transition from a laboratory prototype to a stable, reproducible, and production-ready calibration solution suitable for serial or small-scale manufacturing.

Key challenges:

- Lack of a finalized industrial design of the device;
- Insufficient standardization of calibration procedures for different types of sensors;
- The need to improve the stability and repeatability of measurements under varying operating conditions;

- The need to reduce calibration costs to enable widespread adoption.

Technical and business objectives of the project:

- Advance the device to **TRL 6–7** (demonstration in a relevant operational environment);
- Achieve calibration accuracy at the **0.1–0.5%** level;
- Reduce calibration time by at least **30–50%** compared with existing methods;
- Develop a universal calibration platform supporting at least **three types of sensors**;
- Prepare the solution for commercialization and industrial deployment of various measurement systems, including accelerometers, velocimeters, and laser displacement meters.

Description of the proposed solution: Within the framework of the project, a finalized prototype of a laser calibration platform for geophysical sensors will be developed for the precise calibration of accelerometers, velocimeters, and laser displacement meters. The system is based on high-precision laser measurements serving as the reference channel, enabling the generation of controlled motion while simultaneously performing synchronized measurements of the test sensors and the laser reference channel.

The functional architecture of the prototype includes:

- A laser interferometric/triangulation module for displacement measurement;
- A mechanical electrodynamic vibration shaker for generating controlled motion;
- A high-precision digital data acquisition system for the synchronous collection of data from multiple types of sensors (<http://seismo.kiev.ua/Adv/ADCx24BITS/ADVxTOVxRODENx24xBITSxADCx002a.pdf>);
- A software module for signal analysis and automatic error estimation;
- A module for generating digital calibration coefficients.

Operating principle: The platform generates controlled dynamic motion that is measured simultaneously by the laser system (reference standard) and the geophysical sensors under test. The acquired signals are synchronized and compared in real time, enabling the determination of systematic and random measurement errors as well as the evaluation of the frequency response of the calibrated devices.

How the solution addresses the challenges:

- Improves calibration accuracy through the use of a laser reference standard;
- Ensures measurement repeatability through a fully automated calibration procedure;
- Enables calibration of different types of sensors on a single platform;
- Reduces dependence on manual processing and human factors;
- Provides a foundation for industrial implementation.

The project will result in a universal industrial demonstrator that can serve as a core platform for the future commercialization of laser calibration systems in other countries worldwide.

Description of current State-of-the-art: Existing approaches to calibrating geophysical sensors are predominantly based on mechanical or electrodynamic test benches with limited accuracy and a significant dependence on manual data processing procedures. Such systems often fail to provide sufficient repeatability of results under varying operating conditions and have limitations in terms of universality across different sensor types. The proposed solution exceeds the current state of the art by employing laser metrology as a high-precision reference channel, as well as by fully automating the calibration process and enabling digital synchronization of measurements from different types of sensors. This approach significantly improves accuracy, stability, and repeatability of calibration procedures compared to classical methods. Additionally, within previous research and development efforts, a simplified laboratory prototype of the calibration device

was created and has already been used for calibrating in-house measurement systems, yielding relevant certification results. Practical implementations and testing outcomes of this prototype have been validated in real-world geophysical measurement tasks. References to previous developments and applications: <http://seismo.kiev.ua/Adv/BrhlDev/> <https://lavra.igs-nas.org.ua/DOCS/ACCEL/index.html>

Regarding intellectual property (IPR), the project is based on proprietary developments created by the applicant during prior research and experimental implementations. Potential project outcomes are expected to further advance internal technical solutions and may be subject to intellectual property protection. Based on the current analysis and known technical solutions in this field, there are no apparent external *Freedom-to-Operate (FTO)* constraints that would block the implementation of the proposed system architecture. A final **FTO** assessment will be conducted during the detailed engineering phase of the prototype.

Alignment with the services provided by LASER-PRO: For the implementation of the project, the primary required support within the LASER-PRO program is funding for completing the transition of the existing laboratory prototype into a finalized demonstrator and preparing it for practical deployment. In particular, support from LASER-PRO will enable:

- Completion of the engineering development and optimization of the laser calibration platform;
- Manufacturing and integration of the final prototype;
- Experimental validation and testing under relevant operating conditions;
- Advancement from laboratory level to demonstration level (TRL 6–7);
- Preparation of the solution for further commercialization and industrial use.

Thus, participation in LASER-PRO ensures the final stage of development of the laser metrology technology and its transition to practical application in Ukraine, as well as the production of a new system for the State Enterprise “UKRMETRTESTSTANDARD” fully compliant with EU metrology requirements.

IMPACT

Key exploitable results: The expected key outcomes of the project include the development of a finalized laser calibration platform for geophysical sensors that enables high-precision calibration of accelerometers, velocimeters, and laser displacement meters in an automated mode.

Main results that can be commercially utilized:

- A ready-to-demonstrate and deploy laser calibration system prototype (TRL 6–7);
- A unified platform for calibrating different types of geophysical sensors;
- Software for automatic error calculation and generation of calibration coefficients;
- A laser-reference calibration methodology suitable for standardization and scaling.

These results directly support product development and the business model, enabling the transition from a laboratory prototype to a commercial solution that can be implemented in geophysics, infrastructure monitoring, and industrial metrology.

Expected return on investment (ROI) is driven by:

- Reduction of sensor calibration costs by approximately 30–60% compared to traditional methods;
- Creation of a high-value product in the field of laser metrology;
- Scalability of the platform to international markets.

The global economic value lies in improving access to high-precision calibration of geophysical measurement systems, thereby supporting the development of infrastructure monitoring, seismic research, and industrial safety.

Market opportunity: The proposed innovation creates a competitive advantage through the transition from traditional mechanical calibration methods to high-precision laser metrology with automated data processing. This enables a significant improvement in accuracy, repeatability, and universality of geophysical sensor calibration compared to existing market solutions. The competitive advantage is based on:

- The use of laser-based reference measurement as the primary standard;
- The universality of the platform for different types of sensors;
- Reduced calibration and operational costs;
- The ability to scale the solution across different market levels (laboratory, industrial, and field applications).

The unique selling proposition (USP) lies in the creation of an integrated laser calibration platform that combines high metrological precision with process automation and applicability in real-world operating conditions in any country worldwide. The solution can be protected through intellectual property rights covering system architecture, laser calibration methods, and signal processing algorithms. The value proposition is based on providing affordable high-precision calibration of geophysical sensors, thereby

reducing production costs and improving the quality of measurement systems. The expected market includes geophysical monitoring, seismic research, infrastructure monitoring, and industrial metrology in an international context. This establishes a significant global market for high-precision measurement systems for LLC “RODEN”. Additionally, the developed laser calibration device will enable LLC “RODEN” to supply low-cost yet high-precision seismometers and accelerometers to countries with limited financial resources, expanding the socio-economic impact of the project and opening new markets in developing countries. Expected return on investment is driven by the commercialization of calibration platforms, sales of sensor systems, and provision of high-precision calibration services in the international market.

Go-to-market strategy: The market entry strategy is based on leveraging the established international partner network of LLC “RODEN,” which has extensive experience in cooperation with EU countries and other global markets in various industrial sectors. The primary commercialization approach is a direct B2B supply model combined with technology deployment through existing distributors and engineering partners in the fields of seismic monitoring, infrastructure measurement, and industrial metrology.

Market entry channels include: 1) Existing network of international partners and technical integrators; 2) Direct contracts with scientific institutions and geophysical centers; 3) Participation in international exhibitions and specialized metrology conferences; 4) Cooperation with local engineering companies responsible for regional system implementation; 5) Digital communication and technical marketing channels (website, technical presentations, demonstration cases).

Market entry timeline: 1) Short-term phase (0–12 months): completion of the prototype and demonstration deployments within partner organizations; 2) Mid-term phase (1–3 years): initial commercial deliveries of the calibration platform and sensor systems; 3) Long-term phase (3+ years): scaling of sales to international markets and expansion of the product portfolio.

Thus, market entry is achieved through a combination of existing international connections of LLC “RODEN” and the gradual scaling of the technology via established industrial and scientific distribution channels.

Other expected impacts: The implementation of the project will have a positive social, economic, and technological impact beyond the company itself. In particular, the development of a laser calibration platform will improve access to high-precision calibration of geophysical sensors, thereby supporting the advancement of infrastructure monitoring systems, seismic safety, and scientific research in various countries, including those with limited financial resources. The economic impact lies in the reduction of costs for measurement and calibration solutions, as well as in the creation of new market opportunities for high-precision measurement technologies. The social impact is associated with improved infrastructure safety and enhanced quality of geophysical monitoring, enabling more effective detection and assessment of natural and anthropogenic risks. In the event of grant funding, the project will also enable the establishment of in-house production of high-precision velocimeters, expanding access to modern geophysical measurement systems and increasing the technological independence of Ukraine and other countries with limited financial resources in this field.

IMPLEMENTATION

Work plan description: The total duration of the project is 12 months and is aimed at transitioning from the existing laboratory prototype of a laser calibration system to a finalized demonstration solution ready for near-industrial implementation.

Phase 1 (0–3 months): Engineering optimization and requirements

- analysis of the existing prototype and its technical limitations;
- formulation of final technical requirements for the system;
- definition of the architecture of the laser calibration platform;
- preparation of specifications for hardware and software components.

Result: approved system architecture and technical specification for the final prototype.

Phase 2 (3–7 months): Prototype development and integration

- manufacturing and upgrading of the laser measurement module;
- development of a synchronous data acquisition system;
- integration of a mechanical/vibration test bench;
- creation of software for signal processing and calibration.

Result: a functional laboratory prototype of the integrated platform.

Phase 3 (7–10 months): Testing and validation

- conducting a series of experiments with accelerometers, velocimeters, and laser displacement sensors;
- evaluation of measurement accuracy, stability, and repeatability;

- optimization of calibration algorithms;
- verification of compliance with target KPIs.

Result: confirmed metrological characteristics and stable system operation.

Phase 4 (10–12 months): Demonstration and preparation for implementation

- final optimization of the design;
- preparation of a demonstration sample;
- documentation of results and methodology;
- preparation for transition to TRL 6–7 level and commercialization.

Result: a ready demonstration prototype suitable for industrial implementation.

Resources to be committed: LLC “RODEN” will ensure project implementation using its own internal resources, including scientific and technical personnel, engineering competencies in the field of geophysical measurement systems, as well as its existing laboratory and experimental base for prototype development and testing. The following will be involved in the project execution:

- the in-house team of developers and engineers;
- existing infrastructure for the design, assembly, and testing of measurement systems;
- internal software and hardware developments in the field of laser metrology and calibration.

The involvement of external suppliers or third parties in the supply chain is not planned, as all key components are developed and integrated in-house within LLC “RODEN”. Accordingly, no access to external resources or additional support from other partners of the LASER-PRO consortium is required for project implementation.

TRL level: The current state of development of the laser calibration platform corresponds to TRL 4–5, as a laboratory-validated prototype exists that has demonstrated the functionality of the basic principles of laser reference calibration of geophysical sensors and has been successfully used in test deployments of certified equipment (seismo.kiev.ua, lavra.igs-nas.org.ua). Within previous developments, an industrial working model of the calibration device has been created, which has already been used for calibrating measurement devices of LLC “RODEN”’s own production and has provided practical results and certification confirmations. The company also has high-precision manufacturing and measurement equipment, which provides a foundation for further engineering development of the system. *The objective of the project is to increase the technology readiness level to TRL 6–7, which includes:* 1) creation of a finalized integrated prototype; 2) its demonstration in conditions close to industrial environments; 3) confirmation of measurement stability, accuracy, and repeatability in real-world scenarios. Thus, the project ensures a transition from a laboratory-validated technology to an industrial-level solution suitable for further commercialization and deployment of the company’s proprietary seismometers in other countries.

Risk management: During the implementation of the project, technological, business, and managerial risks may arise, associated with the transition from a laboratory prototype to a demonstration and pre-commercial level.

Technological risks: The main risk is possible instability or insufficient repeatability of measurements when integrating the laser reference module with different types of geophysical sensors.

Mitigation: • step-by-step testing of each system module;

- use of proven laser metrology components;
- calibration and validation on multiple types of sensors;
- application of internal developments of LLC “RODEN” and existing high-precision measurement equipment.

Business risks: The risk lies in possible delays in commercialization or limited market acceptance of the new technology due to the conservative nature of the measurement systems market or military events in Ukraine.

Mitigation: • use of LLC “RODEN”’s existing international partner network;

- early demonstration of the prototype to key customers;
- adaptation of the solution for different market segments (science, industry, infrastructure);
- parallel preparation of a business model already at the development stage.

Managerial risks: The risk is related to the coordination of development, testing, and system integration stages within a limited project timeframe.

Mitigation: • clear division of the project into stages with milestones;

- internal project management within LLC “RODEN” without reliance on external contractors;
- regular monitoring of KPIs and technical indicators;
- use of accumulated experience from previous developments of laser calibration systems.