



Karelia

KARELIA-AMMATTIKORKEAKOULU | KARELIA UNIVERSITY OF APPLIED SCIENCES

Precision Engineering

Precision engineering is deeper understanding of manufacturing processes, metrology and material science to generate added value to product performance through functionality. Precision engineering combines designing, manufacturing and quality control at higher level as a combined process

M.Sc (tech) Juha Väyrynen

Maintain process controls and tolerances that function under extremely tight specifications

<http://projektit.karelia.fi/upu/>

<https://www.karelia.fi/tarkkuustekniikka/>

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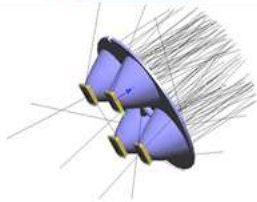
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Research, education and product development since 1994

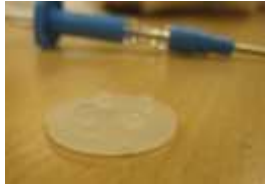


- Excellent precision manufacturing facilities: diamond turning, high speed machining, injection moulding, metal injection moulding and metrology
- Applied research with companies (polymers, locking and security, forestry machines, medical components), telecommunication background
- Educational and research services
- Equipment worth 3000 k€, R&D budget 700 - 1000 k€ yearly external funding (EU regional and national funding)
- Over +50 industrial clients and partners

Developing precision engineering at Karelia



LED optics



Plastic medical products



Environment
Metrology parts



Functional surfaces
for biotechnologies



Forestry
machinery



Locking &
security

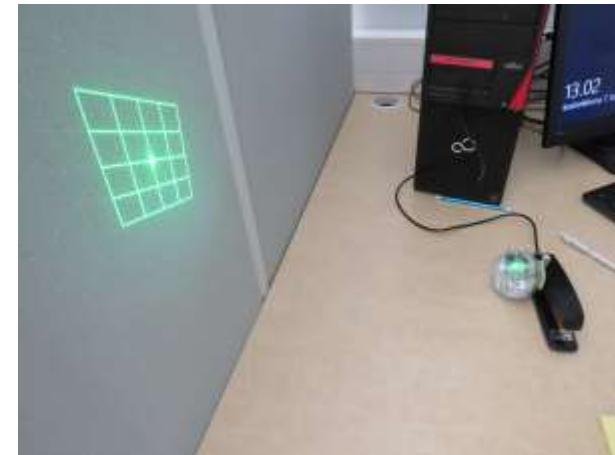
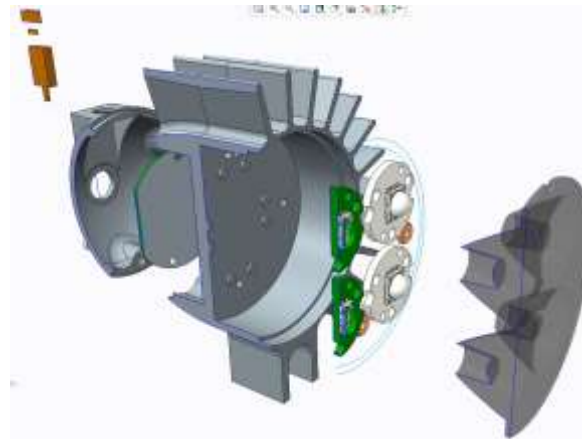
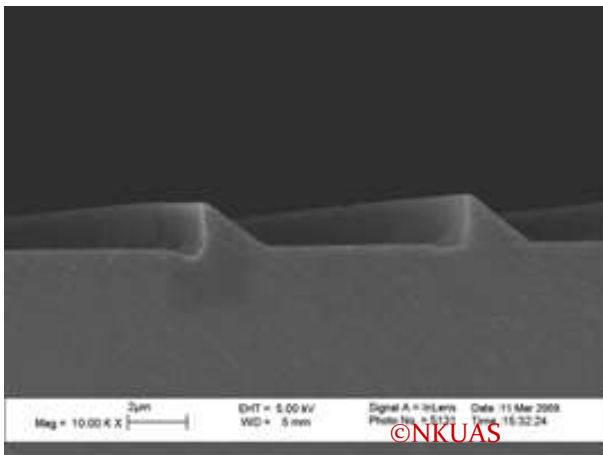
Companies

Educational development

- Developing the precision manufacturing laboratories in conjunction with Finnish industry needs
- Technology and knowledge transfer to companies
- Development of new manufacturing processes
- Development of new products
- Precision Engineering research programs, education, and industrial short courses
- Precision manufacturing prototyping services: diamond turning, high speed milling, injection moulding, large scale metrology, Metal Injection Moulding-process
- Industrial short courses
- R&D staff: 1 (R&D management) + 3 (teachers) + 2 (laboratory engineers) + 2 (project workers)
- Mechanical Engineering (bachelor degree programme)
- 240 credits students intake 40 yearly study duration 4 years

R&D and product development for plastics and metal component manufacturing

- Design of polymer components
- Injection mold design, manufacturing, injection and metrology
- Integration of optics and electronics
- Precision manufactured components and metrology
- Functional micro and nanostructures
- Development of polymer LED optics
- Metal injection moulding prototype process



Jointly created research platform for micro and nanopatterned photonics

Demonstration platform; Research examples:

- Lighting standards review (displays, vehicles, motion detection)
- New iterative optical design method simulations for SSL light sources
- Designing, manufacturing and testing of demonstrational components
- Research on new light sources
- Research and testing of new materials (UV roll to roll)
- FreeForm-surface design manufacturing and metrology
- Diamond machining of seamless thin film rollers
- Reducing glare and light pollution
- On-line metrology for UV roll to roll production
- Improving light coupling to light guides
- Reducing component numbers in lighting products

Research needs

Industrial partnership
creates the platform

Reports, studies and
prototypes

Benefits:

- Faster product development cycle
- More accurate and faster response to new customers product capability enquires
- Gaining competitive advantage
- Clear and fast communication through R&D chain
- Lowering the risks on demonstrations
- Product development, new production technologies and quality improvement
- New business areas and applications based on joint knowledge and technologies

Lighting standards and regulations

Business areas and applications:

Special lighting

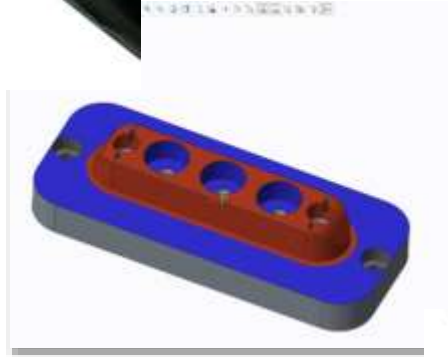
Light guides

Optical feature and
motion detection

Moulds and small
scale production

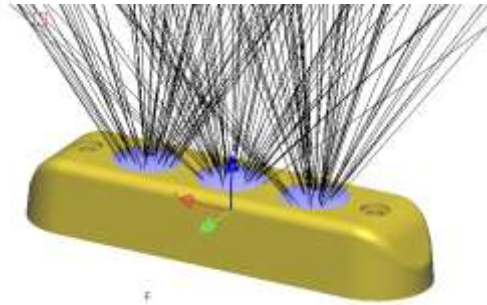
Medical devices

From new idea into a product



In-conjunction with design, manufacturing, metrology and testing technologies

From requirements: technical, optical, legislative (conformity), aesthetic, functionality, weathering, safety, recycling and standards



In to a viable product



Karelia Industrial course – optical component manufacturing

This joint workshop with manufacturing industry will go through with real life examples the limitations and critical steps of prototyping optical parts or devices. This workshop will highlight some difficulties and possibilities while going through a product development cycle of photonics devices.

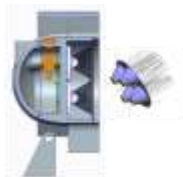
The course will have a hands on session where an optical quality freeform steel insert for moulding application will be manufactured, measured and moulded. The hands on session will be accompanied by going through several case studies of precision engineered demonstrators manufactured by Karelia. The case studies will handle the following topics (published at EUSPEN and SPIE conferences):

- ALD coated freeform spectrometer mirror
- Combination process of diamond machining and roll-to-roll UV-replication for thin film micro- and nanostructures
- Practical Shrinkage Compensation method for Injection Moulded LED Optic
- Ultrasonic vibration cutting of freeform steel insert
- Injection moulded lens array for imaging application
- Fabrication of hybrid optical line generator by direct machining

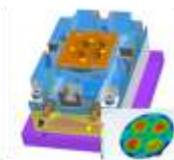
Tailored industrial courses



Standards for LED devices



SSL optical, mechanical and electronics design



Moulded part design and mould design



Manufacturing of optical inserts by diamond turning, lithography or as a combination

Type: on-site training in a precision engineering laboratory at Karelia University

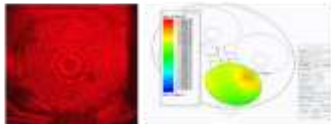
Duration: 3-4 days (case studies, theory of precision manufacturing and laboratory sessions)

Course material: precision manufacturing theory package and publications

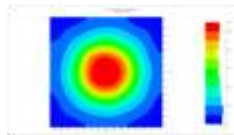
To whom: R&D managers of optical manufacturing, precision machine tool operators, metrology specialists optical designers, product development specialists etc.



Replication injection moulding or UV-curable replication



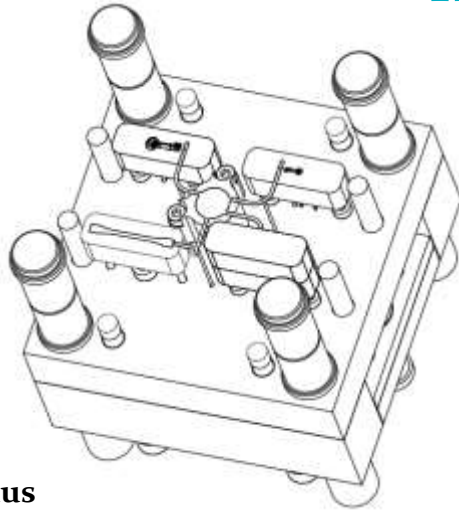
Functionality testing and surface metrology



Reversing metrology data back to optomechanical design

Karelia koulutus tarjonta - suurnopeustyöstö ja muotinvalmistus

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Tämän koulutuspaketin tarkoituksena on selventää yrityksille tarkkuusvalmistuksen soveltamista muotti osien valmistamisessa tarkkuustyöstöympäristössä. Koulutuspaketti voidaan räätälöidä koulutettavan yrityksen oman tuotteen valmistuksen ympärille. Koulutus on suunnattu erityisesti tarkkuustyöstöä ja tarkkuuskomponentteja valmistaville yrityksille

Tyyppi: räätälöity koulutus paikan päällä laboratorioympäristössä Karelia Ammattikorkeakoulu

Kesto: 2-3 päivää (teoria ja laboratorio valmistus)

Kurssimateriaali: tarkkuustyöstön teoriapaketti osallistujille

Kenelle: tuote- ja tuotannon suunnittelijat, valmistuspäälliköt, työstökoneiden operaattorit / ohjelmoijat, mittahenkilöstö jne

Teoria osuus

- Muottirakenteen analyysi valmistustekniikoiden osalta
- Teoria osuus: suurnopeus ja kovatyöstö, kiinnitinjärjestelmät ja mittausmenetelmät
- MIM-valmistus prosessi (Metal Injection Moulding)
- CAM ohjelmointi: 3-akseliset suurnopeusradat viimeistelyssä, lastuamisarvot, 3D mallit ja paletointi, parametriset työstöradat CREO, työkalukirjastot, kiinnitinkirjastot, viimeistelyradat PowerMill, suurnopeustyöstöstrategiat, lastuamisarvot, 5-akseliset työstöradat

Työstö osuus ja teoria osuus

- Kappaleen kiinnitys palettiin ja esiasetus koordinaattimittakoneella
- Suurnopeustyöstö kovatyöstö Mikronilla XSM 400 (koneen operointi, lämpötilanhallinta, terien asettelu/mittaaminen)
- Kappaleen mittaaminen paletissa Wenzel koordinaattimittakoneella
- Muut mittausmenetelmät (Nivelvarsimitaus Faro, videomittaus, profilometria)
- Pistedatan vertaaminen 3D malliin
- Tarkkuustyöstökoneen valinnasta

Räätälöidyt tilauskoulutukset