SIMTRUM

Ultra-Precision Diamond Turning Tools & Optics

2022 V1

For customized projects please Contact us:

info@simtrum.com

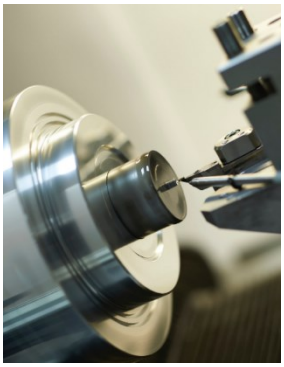
Introduction

Diamond Turning (Single Point Diamond Turning) is a manufacturing process used to quickly produce low to moderate volumes of highly accurate plastic optics, usually to support R&D or prototyping efforts.

The machine that does the single point diamond turning is a precision CNC lathe. The cutting tool is a diamond that has been specially prepared to cut the required surface geometry of the lens. Diamond turning is used to create light weight aspheric plastic lenses and is capable of cutting freeform polymer optics as well. Because the surface is generated on a CNC lathe, the process is very deterministic and highly repeatable, with surface form errors as low as 2 waves per 2.5 cm of diameter. Because the cutting tool is actually a diamond, surface finishes of 3 to 4 nanometers (Ra) are regularly achieved. With surface finishes this fine, the diamond turned optics are very specular, require no post-machine polishing, and can be readily coated with either a multi-layer thin film coating, for enhanced transmission.

Customer-Specific Ultra-Precision Tool Inserts

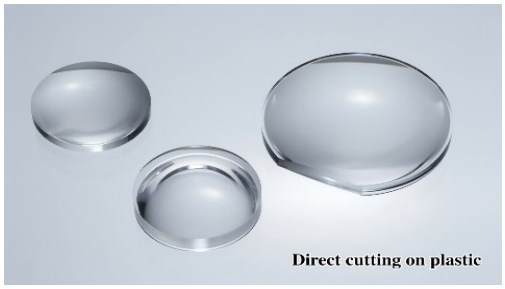
- Elliptical Fresnel
- Racetrack Fresnel
- Concentric Lines
- Micro Lens Array
- Linear Fresnel
- Fly Eye Lens
- Micro Lenses
- Aspherical
- Spherical
- Freeform
- Pyramid
- Toric



Diamond Turning Tool Inserts

Established DT Tool Insert Materials

- Aluminium, Brass, Copper, Beryllium Copper
- Nickel-Phosphor
- Steel



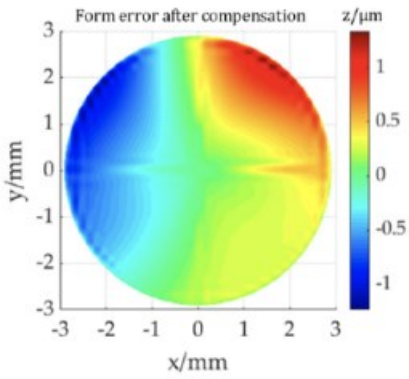
Direct Diamond Turning on Plastics

Direct Diamond Turning on Plastics

- Zeonex Cyclo Olefin Polymer (COP)
- Polymethyl methacrylate (PMMA)
- Polycarbonates(PC)

Single Point Diamond Turning(SPDT) Lathes

- 3 - Axis (Moore's Nanotech)
- 5 - Axis (Moore's Nanotech)
- Son-X Ultrasonic Attachments



Submicron Forth Accuracy, Ra<5um

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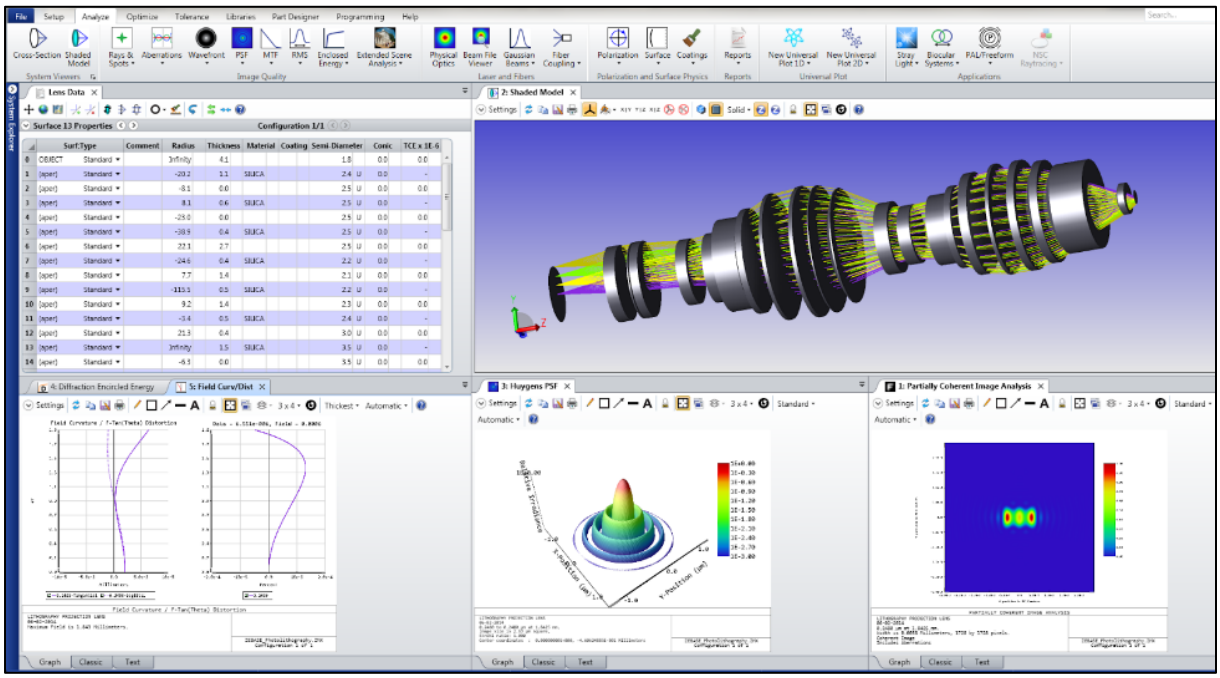
Optical Design & Simulation Software

Zemax OpticStudio

Refractive imaging & illumination designs & simulations.

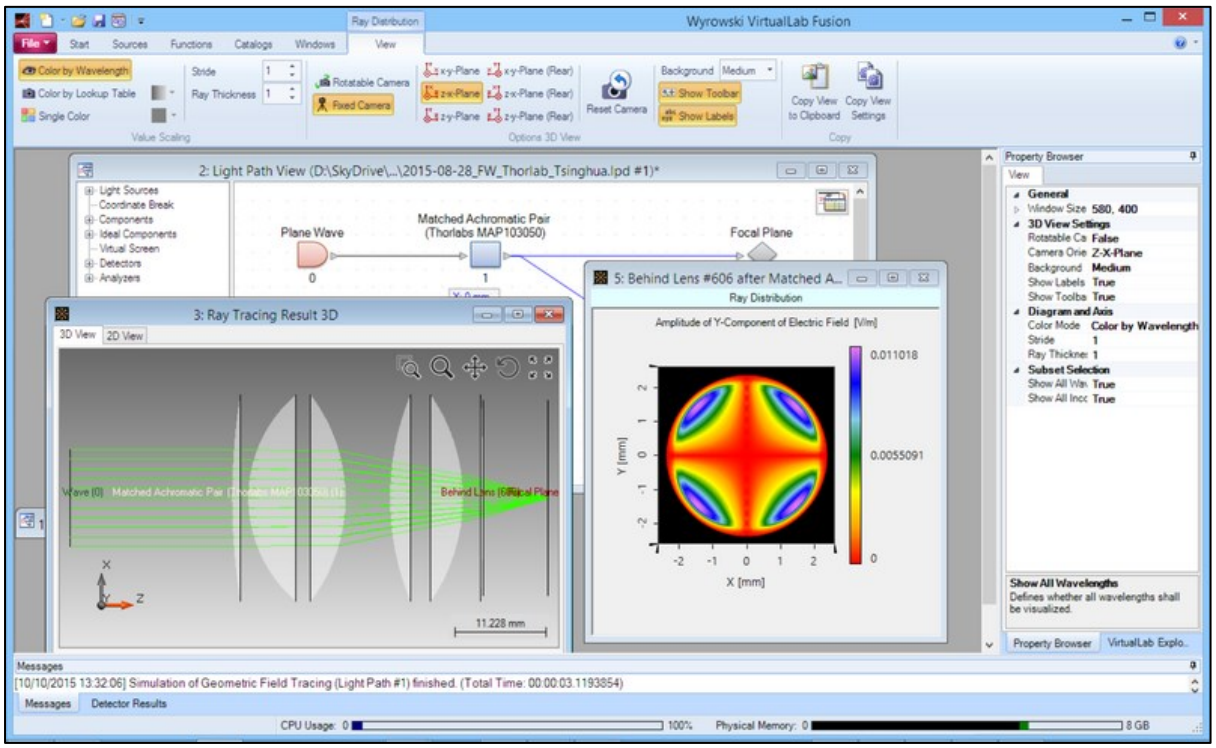
Zemax



LightTrans VirtualLab

Design & optimization of diffractive beam-splitters, beam-shapers, diffusors and custom image projectors for a single wavelength light sources.

LIGHTTRANS



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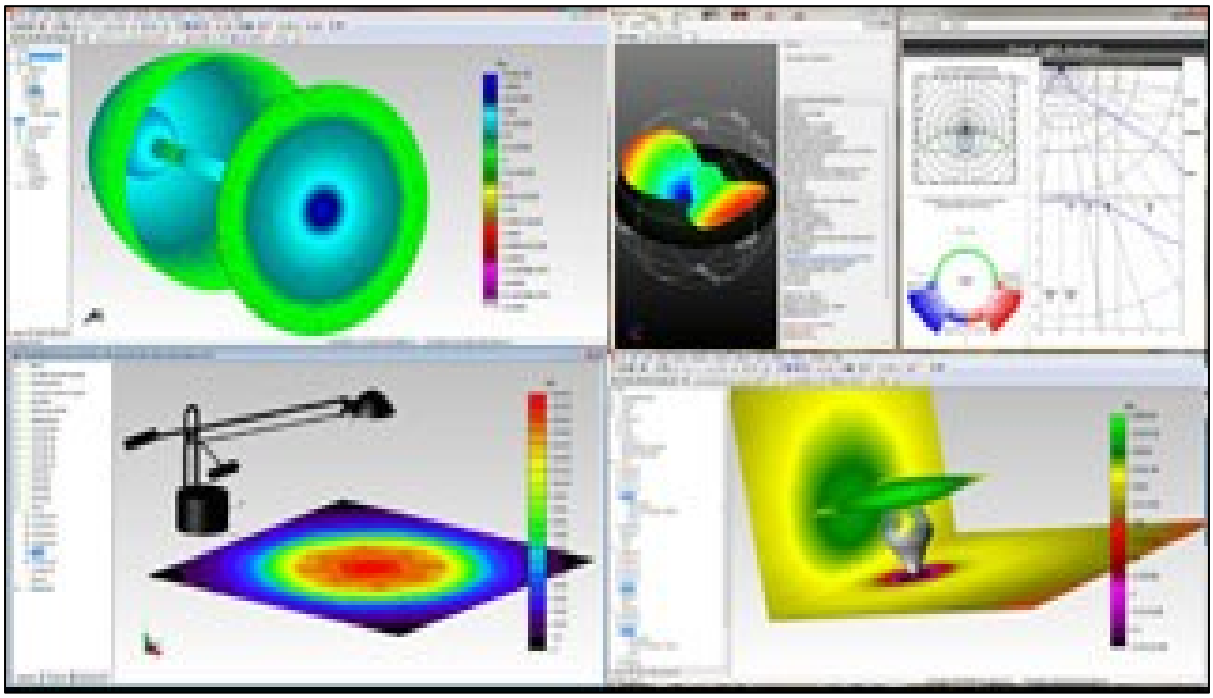
Optical Design & Simulation Software

TracePro

Simulation of the propagation of light through any optomechanical system by raytracing.

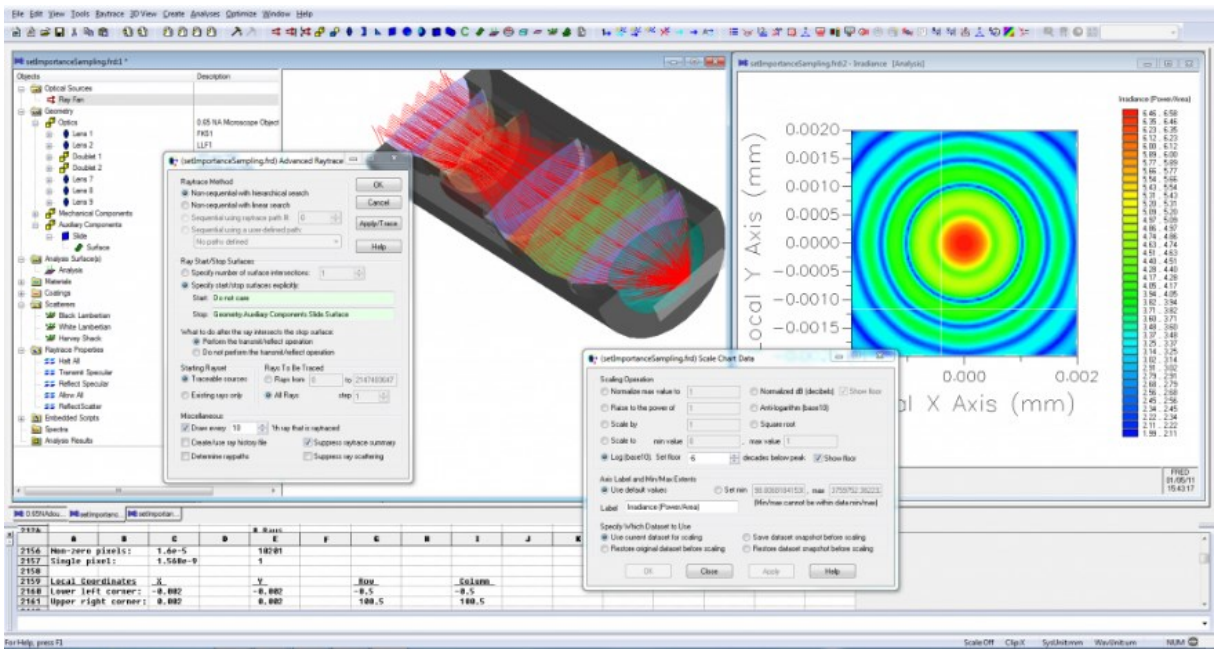
TracePro



FRED

Simulation of the propagation of light through any optomechanical system by raytracing.

FRED Optimum



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Equipment

DKSH Nanotech 250UPI V2 Compact diamond turning lathe

- Diamond Turning Lathe with 3 axes to produce spherical & aspheric optical lenses, mirrors, mold pins, freeform optics and mechanical components.
- Sub-nanometer level surface finishes and sub-micron form accuracies, directly off the machine in a wide variety of materials.
- Workpiece capacity of Ø300mm and 200mm long.
- Granite base structure with passive air isolation system ideal for ultra precision needs.

Features

- Compact Diamond Turning Lathe
- Optional C Rotary with Linear Y or Rotary B Axis
- Mechanical Design Strengths

Technical Data

General	Description
System Configuration	Ultra-Precision two, three, or four axis CNC contouring machine with “T” axis orientation
Workpiece Capacity	300mm diameter x 200mm long (150mm diameter swing capability over the optional rotary B-Axis)
Base Structure	Natural Black Granite with integral slide channels and protective stainless steel apron
Vibration Isolation	Optimally located air isolation system. Optional Shear Damped Air Isolation System with Self Leveling
Computer System Specifications	Intel i5 2.4 GHz processor running Windows 7 Professional 64-bit with 16GB DDR3 1600MHz memory, 10/100/1000 Base-T external customer Ethernet connection, DVD RW Drive, 500GB 7200 RPM removeable Hard Drive. Pendant features a 22” wide projected capacitive multi-touch display. Customer USB ports provided on front of PC and also on operator pendant.
Control System	Delta Tau 1GHz PowerPMAC Embedded Real-time 64-bit Linux Motion Controller with Nanotech’s NEW Windows 7 based HMI with a Touch / Swipe Gesture Interactive display.
Programming Resolution	0.01 nanometer linear / 0.0000001° rotary
Functional Performance (As measured with laser interferometer & white light interferometer on same part)	Material – High Purity Aluminum Alloy Form Accuracy (P-V): ≤ 0.1µm / 75mm diameter, 250mm radius convex sphere. Surface Finish (Ra): ≤ 2.0 nanometers *(Important Notice: Both Form & Surface Finish measured on the same part, same surface!)*
Workholding Spindle	**Heavy Duty (Standard)**
Type	Exclusive impact resistant porous graphite air bearing with center mounted thrust face
Liquid Cooling (optional)	To maintain thermal stability and tool center repeatability, a closed loop chiller provides recirculating temperature controlled water to cooling channels located around the motor and bearing journals of the air bearing spindle. The chiller has an integral PID controller which maintains temperature control to ±0.5°F.
Speed Range	50 to 10,000 rpm, bi-directional
Swing Capacity	Up to 300mm diameter (without risers)
Working Load Capacity (Radial)	85 Kg @ 7bar (185 lbs @ 100psi.) / 102 Kg @ 10bar (225 lbs @ 145psi.) @ spindle nose
Working Load Capacity (Axial)	197 Kg @ 7bar (435 lbs @ 100psi.) @ spindle nose
Axial Stiffness	228 N/µm @ 7bar (1,300,000 lbs/in @ 100psi) / 260 N/µm @ 10bar (1,500,000 lbs/in @ 145psi)
Radial Stiffness (at nose)	98 N/µm @ 7bar (560,000 lbs/in @ 100psi) / 140 N/µm @ 10bar (800,000 lbs/in @ 145psi)
Drive System	Frameless, Brushless DC motor
Motion Accuracy	Axial: ≤ 12.5 nanometers (0.5µ”) Radial: ≤ 12.5 nanometers (0.5µ”)

Equipment

DKSH Nanotech 650FG V2 Compact diamond turning lathe

- Diamond Turning system with expandable to 5 axes of linear X, Y, Z , and rotary B, C axes.
- Vertical oil hydrostatic Y-axis with symmetrically integrated main work spindle make it more advanced machining techniques such as raster flycutting of linear diffractives and freeforms, micro-prismatic optical structures and micromilling of aspheric lens arrays possible.
- Workpiece capacity up to Ø650mm and 300mm long.

Features

- Most Versatile Freeform Generator.
- Unique Y-axis Design Proven Exceptional
- Mechanical Design Strengths

Technical Data

General	Description
System Configuration	Ultra-Precision three, four, or five axis CNC machining system for on-axis turning of aspheric and toroidal surfaces; slow-slide servo machining (rotary ruling) of freeform surfaces; and raster flycutting of freeforms, linear diffractives, and prismatic optical structures
Workpiece Capacity	650mm diameter x 300mm long (Note: additional swing capacity available upon request)
Base Structure	Monolithic composite polymer granite base with integral coolant troughs and superb thermal stability
Vibration Isolation	Optimally located air isolation system. Optional Shear Damped air isolation system with Self Leveling
Computer System Specifications	Intel i5 2.4 GHz processor running Windows 7 Professional 64-bit with 16GB DDR3 1600MHz memory, 10/100/1000 Base-T external customer Ethernet connection, DVD RW Drive, 500GB 7200 RPM removeable Hard Drive. Pendant features a 22" wide projected capacitive multi-touch display. Customer USB ports provided on front of PC and also on operator pendant.
Control System	Delta Tau 1GHz PowerPMAC Embedded Real-time 64-bit Linux Motion Controller with Nanotech's NEW Windows 7 based HMI with a Touch / Swipe Gesture Interactive display.
Programming Resolution	0.01 nanometer linear / 0.0000001° rotary
Functional Performance (As measured with laser interferometer & white light interferometer on *same* part)	Material – High purity aluminum alloy. Form Accuracy (P-V): □ 0.15µm / 75mm dia, 250mm convex sphere. Surface Finish (Ra): □ 3.0 nanometers (Test Parts cut in both the X-Z and Y-Z planes) *(Important Notice: Both form and finish are measured on the same part, same surface!)*
Workholding Spindle	**Heavy Duty (Standard)**
Type	Exclusive HD impact resistant graphite air bearing with center mounted thrust face
Liquid Cooling (optional)	To maintain thermal stability and tool center repeatability, a closed loop chiller provides recirculating temperature controlled water to cooling channels located around the motor and bearing journals of the air bearing spindle. The chiller has an integral PID controller which maintains temperature control to ± 0.5°F. Flow is controlled by a solenoid integrated with the machine's CNC control.
Mounting	Centrally integrated within the Y-axis carriage to increase loop stiffness and minimize thermal growth. Spindle cartridge resides in an athermal housing to further enhance thermal stability
Speed Range	50 to 10,000 rpm, bi-directional
Swing Capacity	Up to 650mm diameter
Working Load Capacity (Radial)	85 Kg @ 7bar (185 lbs @ 100psi.) / 102 Kg @ 10bar (225 lbs @ 145psi.) @ spindle nose
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Radial Stiffness (@ spindle nose)	98 N/µm @ 7bar (560,000 lbs/in @ 100psi) / 140 N/µm @ 10bar (800,000 lbs/in @ 145psi)
Drive System	Frameless, Brushless DC motor
Motion Accuracy	Axial: ≤ 12.5 nanometers (0.5µ") Radial: ≤ 12.5 nanometers (0.5µ")

SIMTRUM Singapore
Telephone: +65 6996 0391
Email: info@simtrum.com

SIMTRUM China
Telephone: +86 150 0085 3620
Email: sales@simtrum.cn

www.simtrum.com