# The Elliptecmotor

surface properties of the driven element and their impact on motor performance

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CTO

# Elliptec AG: Who we are

- Elliptec develops, produces and sells **low cost piezo-motors and -actuators**
- Elliptec offers **engineering services and design-in support** for their products
- Headquarters and production facility is in **Dortmund, Germany**

# Elliptec AG: What we do

The Elliptec Module R40

High precision and dynamic piezodrive

easy to use

Elliptec Piezomotor X15G

high precision

high dynamic

low cost

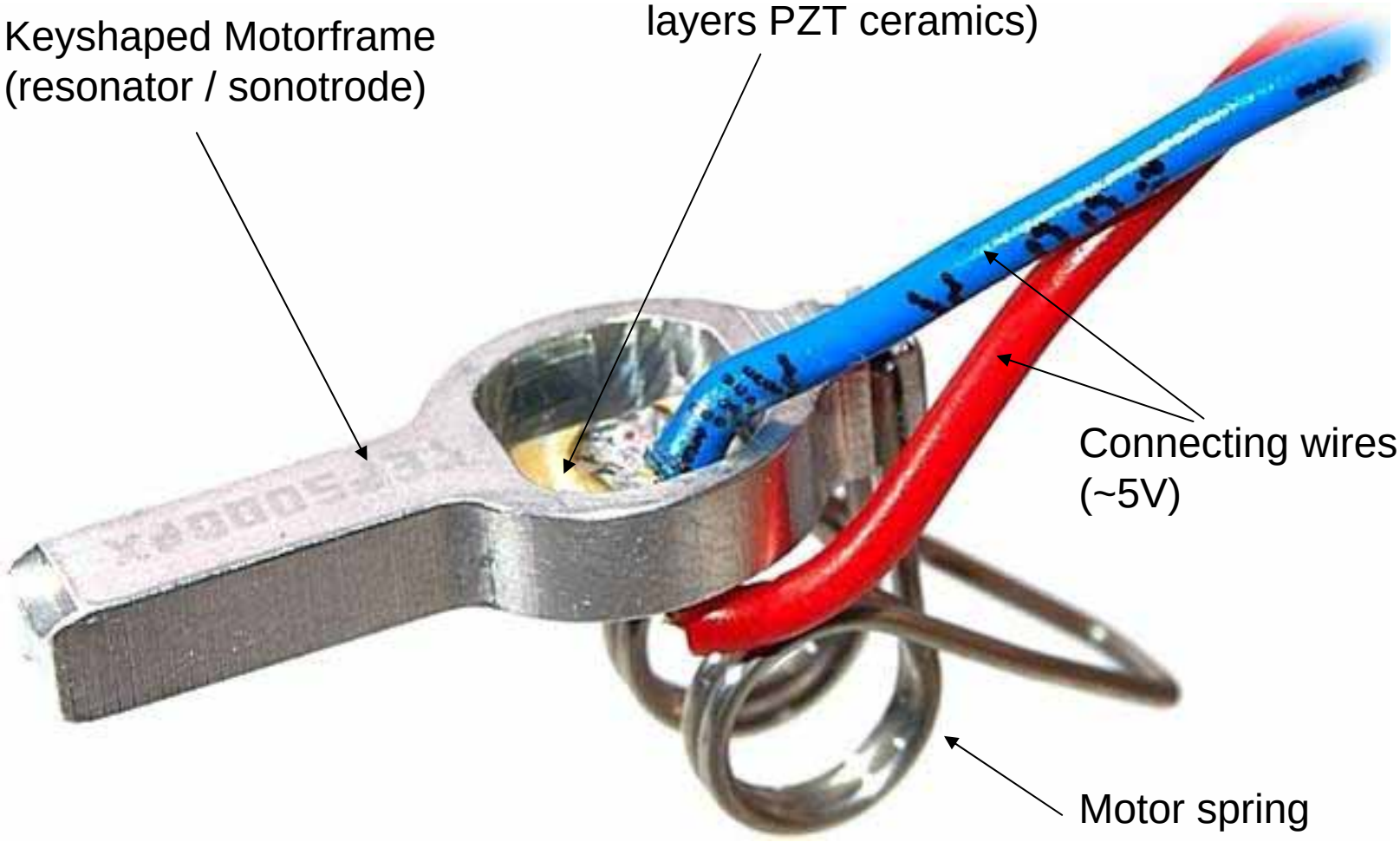
Elliptec Piezoactuator A10E

high precision actuator

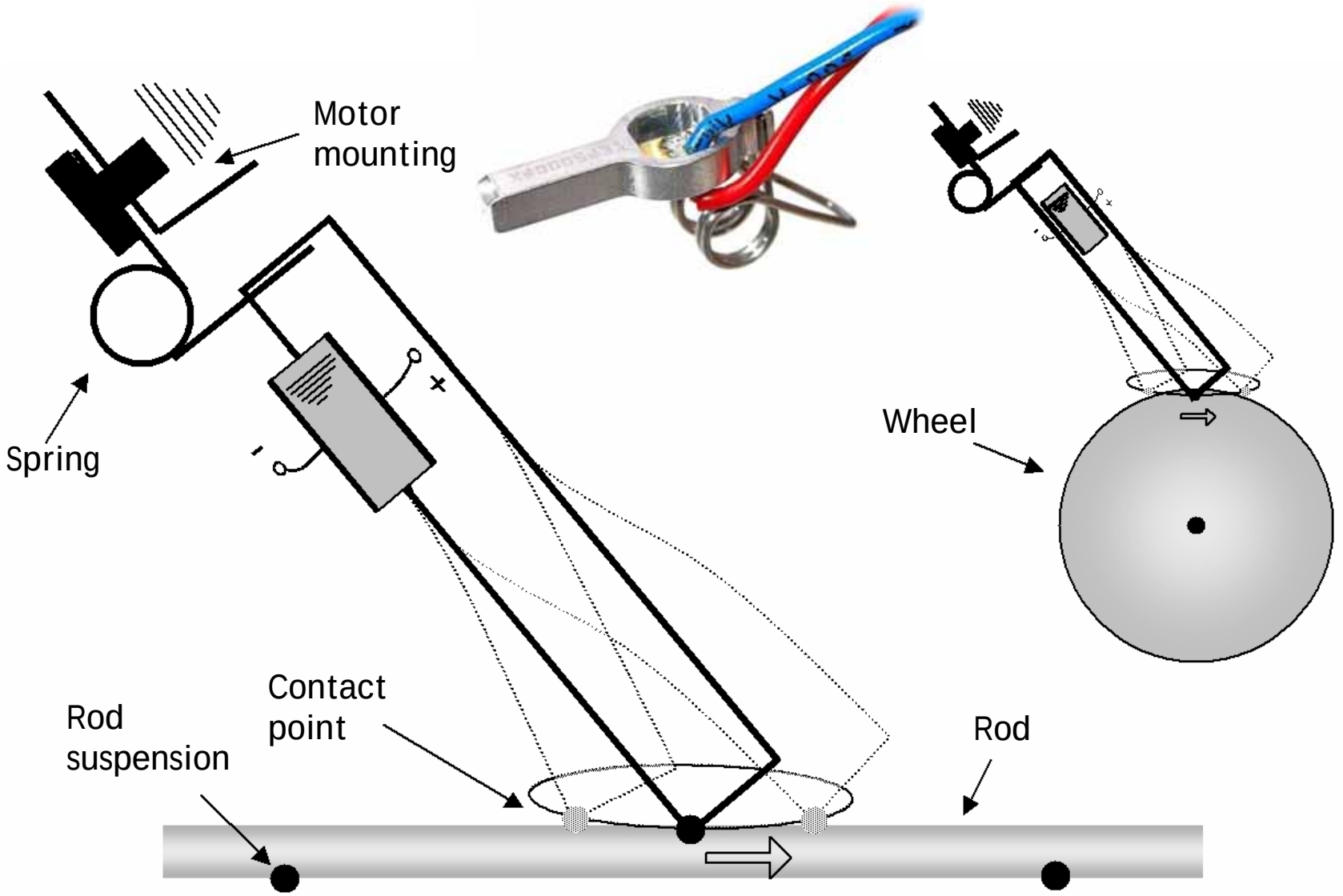
~2µm stroke

low cost

# Elliptec Motor X15G – only 3 functional parts



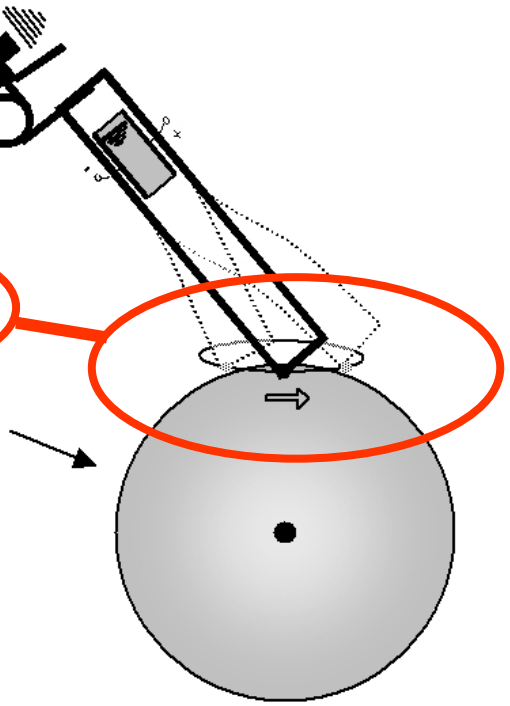
# Elliptec Motor X15G – how it works



# Elliptec Motor X15G – how it works

- driving by small resonant steps
- Driving by friction
- FWD @ 80kHz
- BWD @ 100kHz
- Fast: 300mm/s !

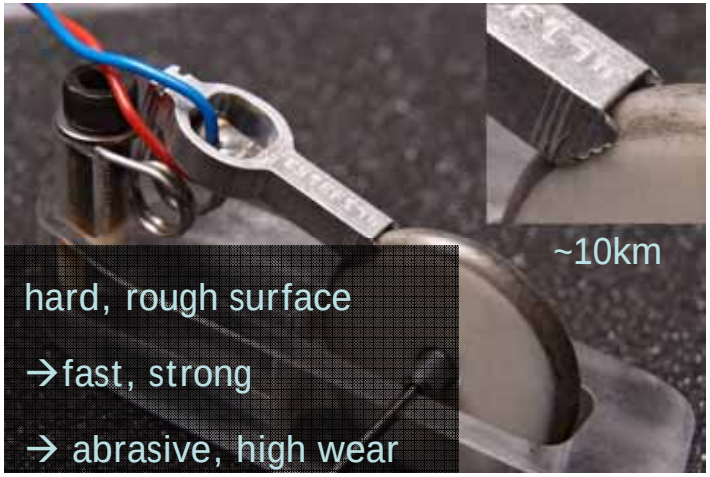
$$\frac{300\,\frac{mm}{s}}{100kHz} = 3\mu m$$



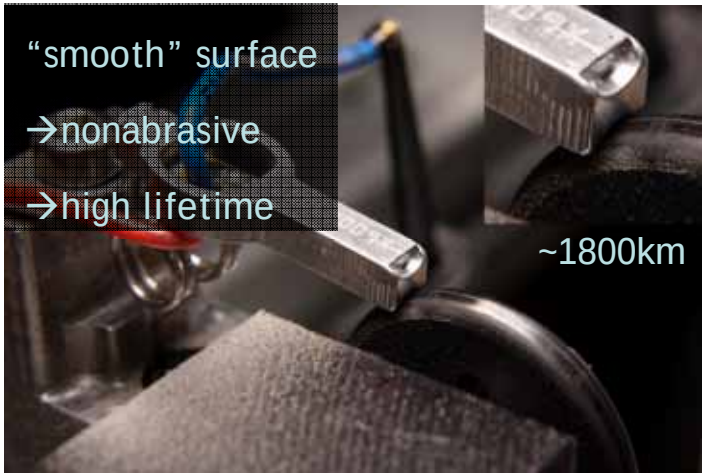
- Precise: <15µm accuracy (simple stop)
- Higher precision (submicron) feasible
- dynamic: start/stop < 5ms
- Low cost
- Direct linear, rotational or XY movement

# Elliptec Motor X15G – Driving surface

- →special recommendations to driving surface
  - Hard Material
  - High friction coefficient
    - Glass fiber reinforced plastics → IXEF1032 (Solvay)
    - Ceramics



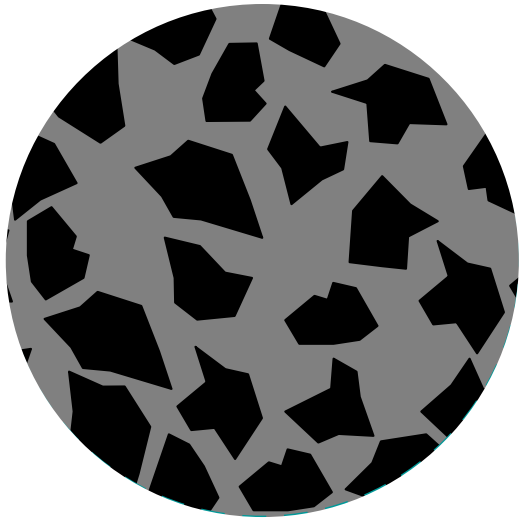

  - Low wear
    - Graphite reinforced Plastics → PF7595 (Hexion Bakelite)

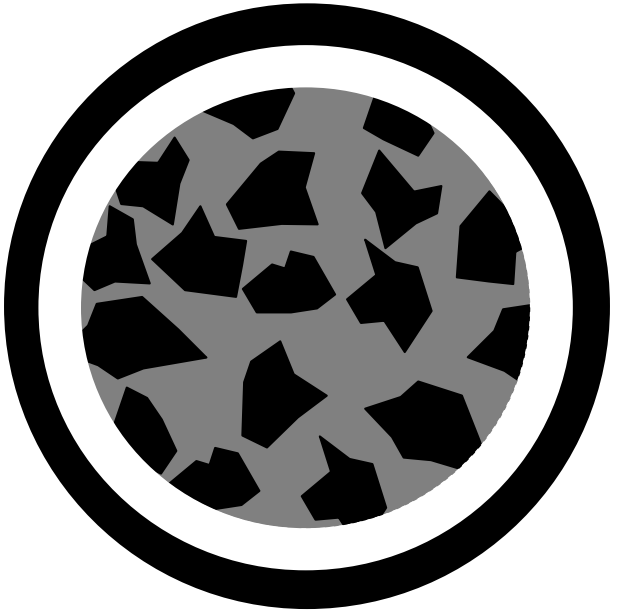



    - Further reduction of wear on very smooth surfaces e.g. by **molding** or **polishing** the wheels

→Surface treatment can optimize performance

# Elliptec Motor X15G – Driving surface





- Bulk material + machining
  - Particles statistically distributed
  - Machine Surface
  - Hard filling particles statistically distributed on surface
  - → Hard surface
  - → Rough surface

  Works good, not optimized for wear

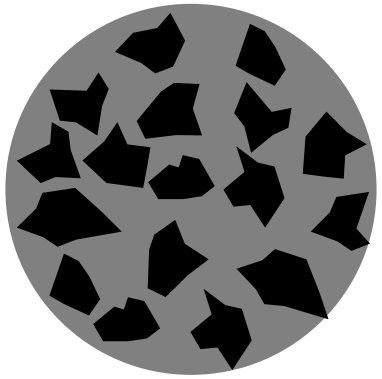
- Molded surface
  - Starting with a mold
  - Filling mold with material
  - Particles held away from surface by molding tool
  - → softer surface without filler
  - → Smooth surface
- →remove surface “skin” to harden surface

Several ways to remove skin→ different performances

# Elliptec Motor X15G – Driving surface

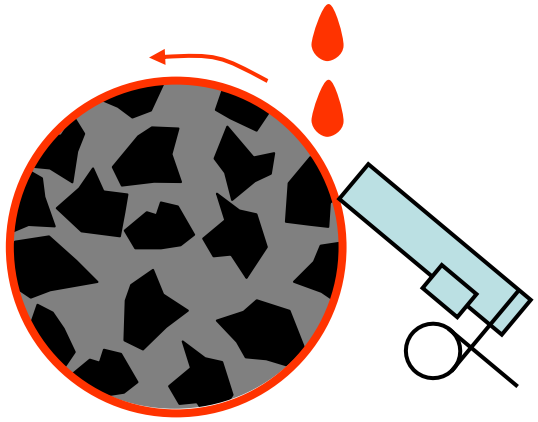
- Surface treatment by oxygen plasma
  - Removal of the surface skin
  - Roughening of the surface
  - Fast “run in” of the motor

  Comparable to machined wheel



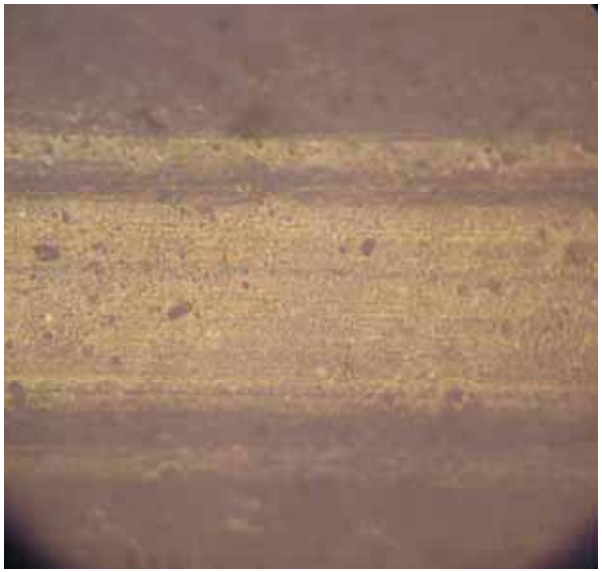
- Surface treatment by mechanical polishing
  - Removal of the surface skin
  - Smooth and highly polished surface
  - Increased “run in” due to low wear

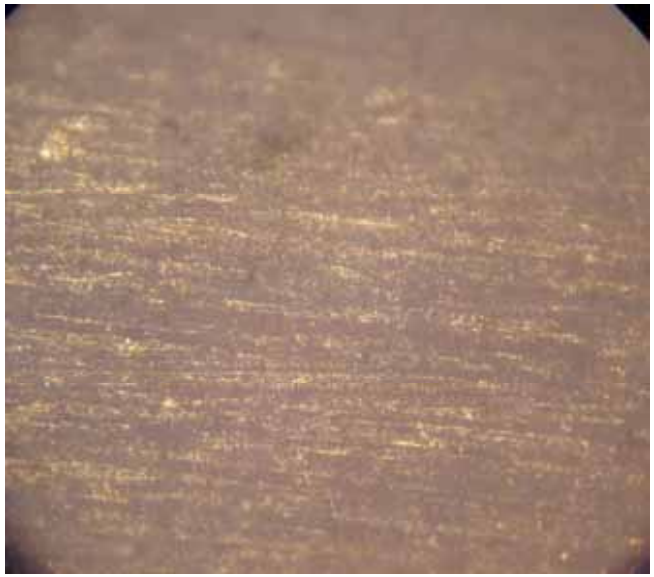
  Very low wear, long „run in“

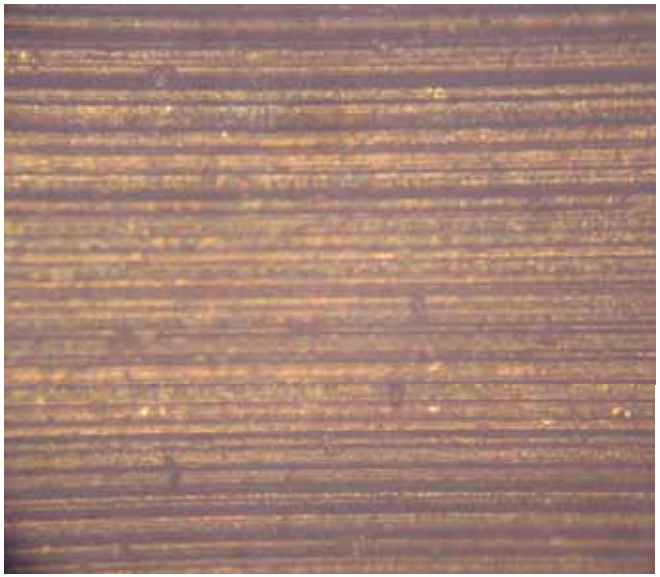


- →Surface Treatment by mechanical polishing on motor tip (accelerated “run-in”)
- → Polishing and fitting of motor tip to wheel

# Elliptec Motor X15G – surface polishing

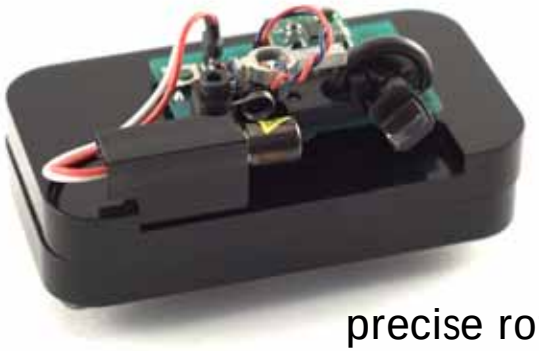






- No surface treatment
  - Smooth surface
  - Soft surface
  - Small contact area
  - Lower starting force / speed especially on molded surfaces
- manual surface treatment
  - Roughened surface
  - Soft “skin” removed
  - Higher force / speed
  - Crossing Patterns
  - Hardly reproducible
- “self polishing” surface treatment
  - Run motor on diamond liquid
  - Soft “skin” removed
  - High force / speed
  - Highly reproducible linear patterns

# One-dimensional Applications



precise rotation of wheel segment for laser positioning

silent rotation of filterwheel without backlash

high precision positioning with increased unpowered holding force

precise and highly dynamic aperture operation for exposure control

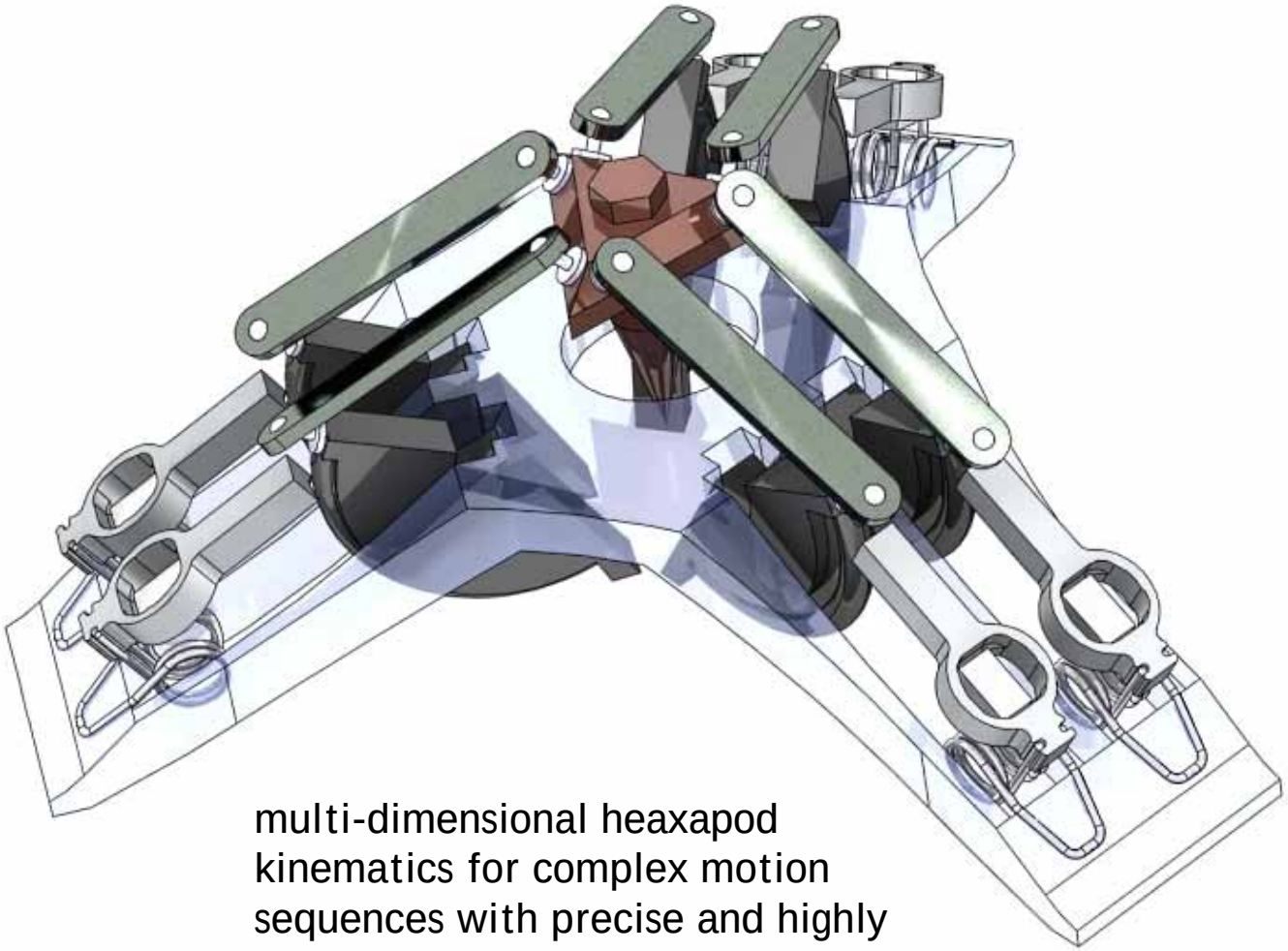
# Two-dimensional Applications

high precision & dynamic 2D positioning prototype

- 20µm step size
- 200mm/s top speed
- <10ms acceleration to top speed
- 11.5 x 11.5mm operation field
- 55 x 50 x 25mm compact size
- Travel time point-to-point <10ms

Precision is limited by the sensor.

# Multi-dimensional Applications



multi-dimensional heaxapod kinematics for complex motion sequences with precise and highly dynamic positioning

# Thank you

for your attention