sincroll
drive technologies

Zero-friction gears

Pal Bogar • founder/CEO

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click pictures for contacts

Change the machine world

My personal journey

Finance, 13 years:

Morgan Stanley etc.
London, New York

Physics, 13 years:

PhD: USA
Postdoc: Germany

Engineering school:

Hungary
Awards

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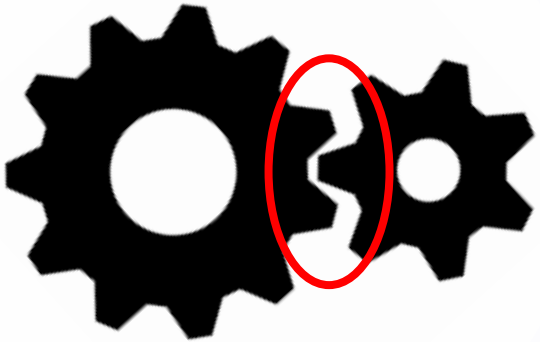
Solve problem:

FRICTION

IN MACHINES

Problem: FRICTION

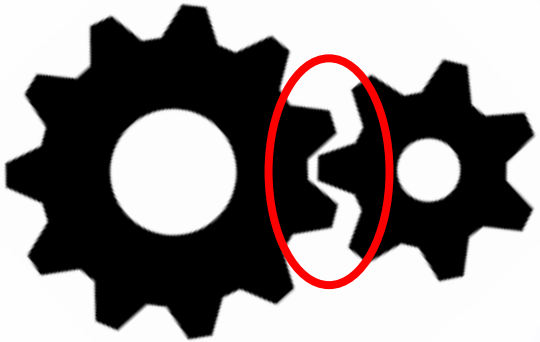
Machines lose energy due to friction in their gears



Gear teeth slide on each other

ALL* machines affected

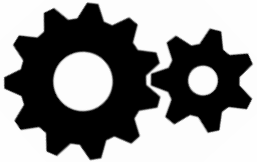
All* machines use gears



* *Exceptions exist*

Gears: critical parts of ALL* machines

Example:

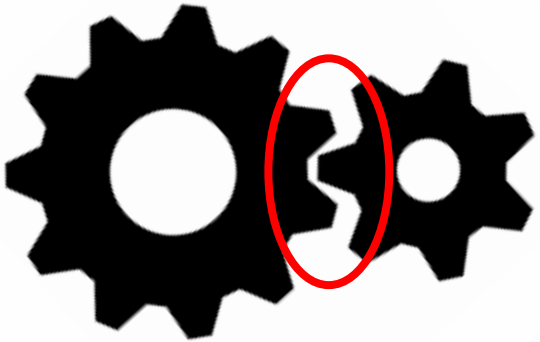
CAR ENGINE >>  >> CAR WHEELS

** Exceptions exist*

Friction: costs $ trillions + CO2 gigatons

Also causes:

Shorter life
Shorter range
Noise & heat
Wear & abrasion
Failure, jam & malfunction
etc



Solution: Re-invent the gears

BALL coupling (no teeth)

Balls purely rolling:

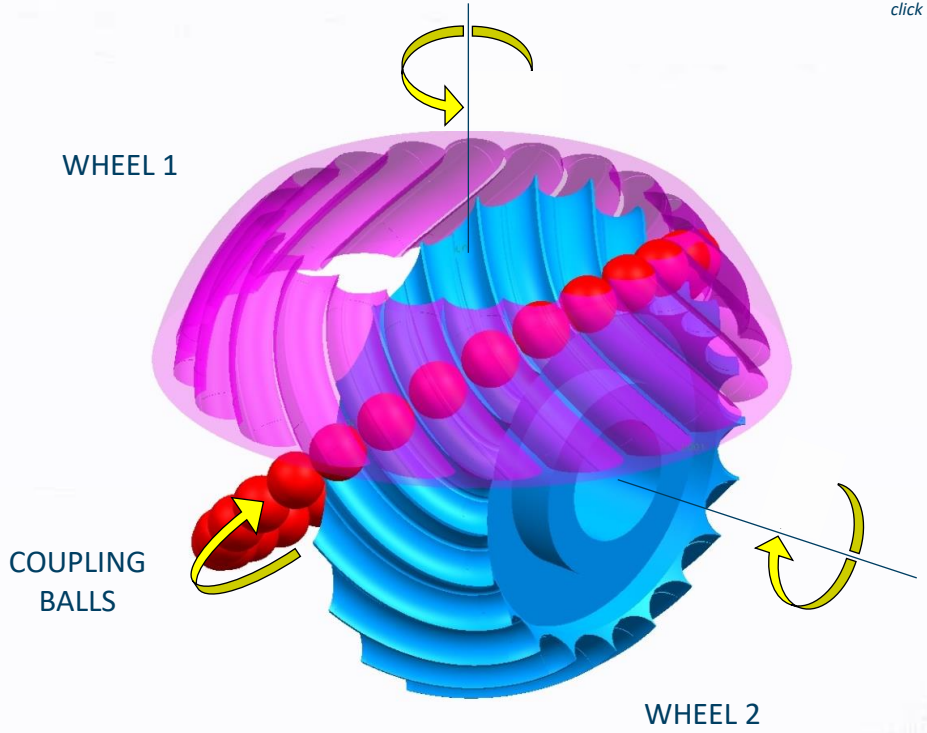
No sliding, no friction, no energy loss

Perfect 100%* efficiency:

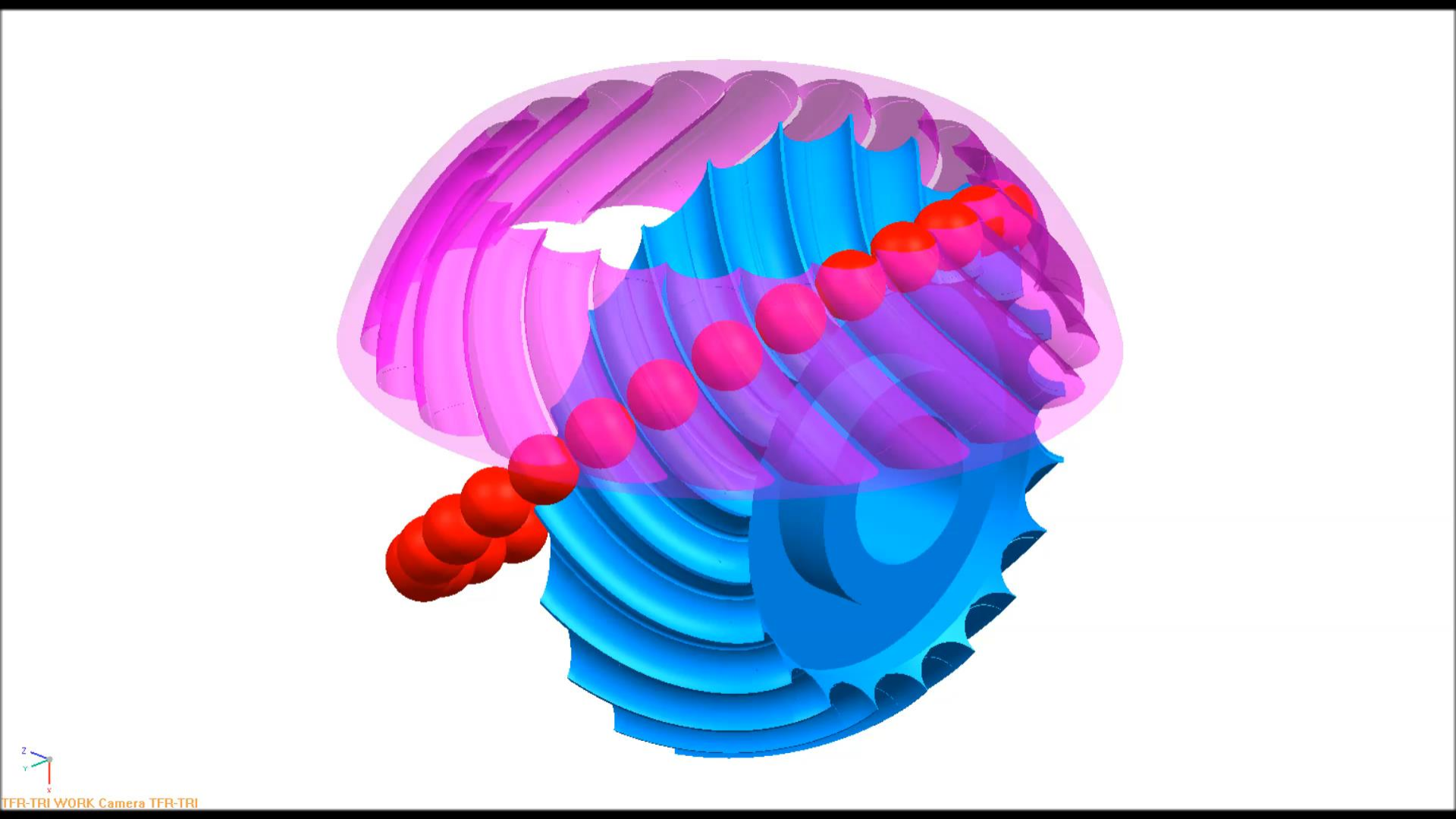
Save $ trillions + CO2 gigatons

Hold back climate warming by 6%

click picture for movie



** At ideal conditions*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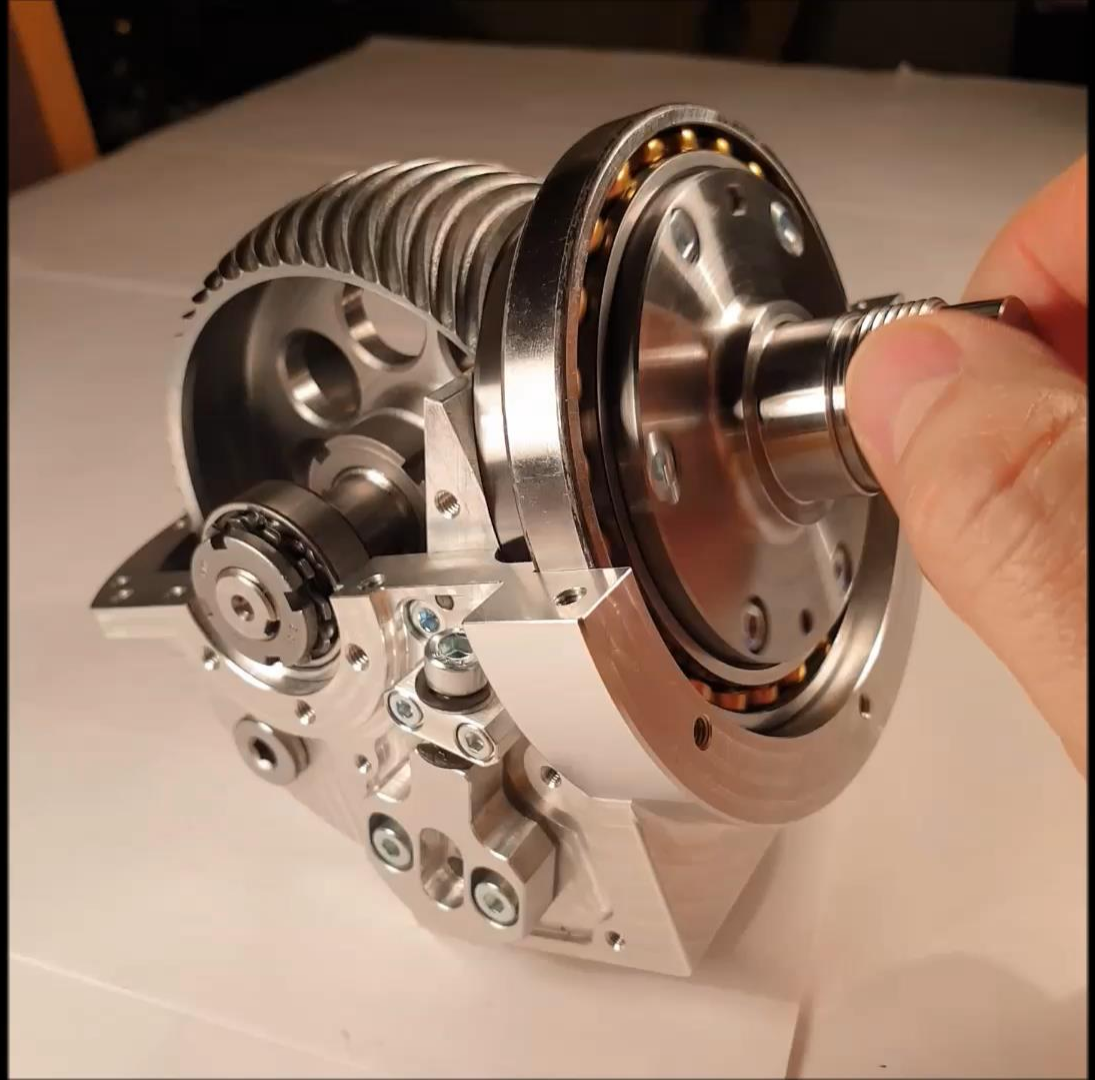
X
TFR-TRI WORK Camera TFR-TRI



PLATFORM technology: tool kit

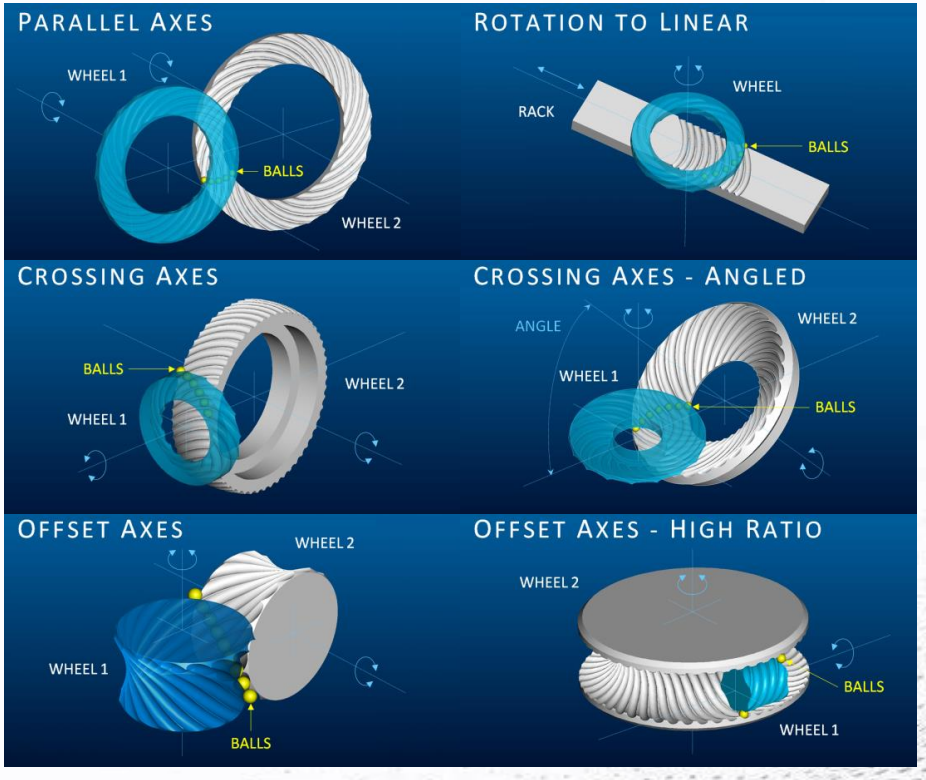
Do ALL specs, applications & industries:

Cover ENTIRE gear universe

Major paradigm shift:

After 2000 years of tooth gear hegemony

DESIGN EXAMPLES:



IP: strategic to our business

Core technology patent granted:

In 11 countries

Freedom To Operate (FTO) in place:

No spin-off, no big corporate, no other owners

No dependence on other IP

Aggressive IP strategy:

Submit 3 patents every year next 20 years !

Market: ALL machines

TAM: **$ 200 billion**

ALL vehicles: ground, air, water, space

ALL non-vehicles: cranes, robots, wind turbines etc.

Competitive edge - years

Deeptech physics know-how, hardware
Massive IP portfolio

No reverse engineering
Re-inventing takes years

Competition mainly tooth gears
But 2000 years old

Business model: combine two

Technology:

Sell IP licenses & engineering services

Making revenues already

Production:

Produce/sell gears in series

Starting up shortly

Combined model:

Major synergies

Massively scalable within & across 100s of markets

Traction: early-stage success

Technology at TRL 6:

Proven in several prototypes

Revenues € 300k so far:

Network of 100s of companies

Investor Mate Rimac:

Founder/CEO of unicorn EV startup - *Europe's Elon Musk*

Grants & awards:

€ 350k in grants
20 awards in 7 countries
incl. China, Germany, UK, US
twice EU Seal of Excellence

click picture for video

Team: 26 years avg. experience

click names for linkedin

Pál Bogár

Founder / CEO

Physics: PhD

Erika Bogár

Founder / COO

Economics: MSc

Zoltán Kovács

Research

Physics: PhD

Gábor Farkas

Engineering Chief

Engineering: MSc

Zoltán Homály

Design & Manuf.

Engineering: MSc

Tibor Hodász

Sales & Marketing

Engineering: MSc

Pál Schmidt

Business Chief

Economics: MSc

Dayu Ren

China Bus. Dev.

Finance: MSc

Advisory Board: founders + industrials + academics

our investor

click names for linkedin

Mate Rimac

Founder:
EVs

Zvonimir Sucic

Founder:
EVs

Peter Jasko

Founder:
Fintech

Prof. Gergely Zimanyi

Founder
Academia
IP law

Prof. Karsten Stahl

Academia: Gears
Industry: Cars

Prof. Marko Tirovic

Academia: Cars

Dr. Franz Joachim

Industry: Gears

Dr. Ralf Hund

Industry: Cars

Dr. Ingo Schulz

Industry:
Bearings

RIMAC
BUGATTI RIMAC

RIMAC
ARRIVAL
TVS

Merrill Lynch
CREDIT SUISSE
J.P.Morgan

UCDAVIS
SIDLEY
Alcon

TUM FZG
BMW

Cranfield University

ZF
TUM FZG

SCHAEFFLER
Audi
ZF

SKF
RWTH AACHEN UNIVERSITY

Fundraising: € 3 million

Finish on-going customer projects - 2 years:

Lock in global licencing deals

Ignite further projects & exponential growth

Many early exit opportunities:

Through strategic acquisitions

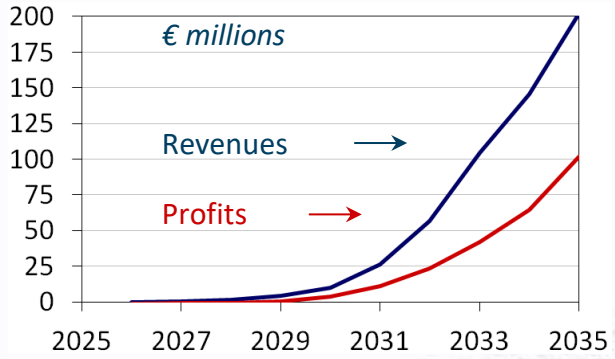
Due to many markets covered

Financial targets:

unicorn

IPO

€ million	...	2033	2040
Revenues	...	**102**	...
Profits	...	**42**	...



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Change the machine world - together

Join us !

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Appendix

Value: MASSIVE efficiency gain - 8% for EVs

Our energy loss

8x smaller

than conventionals

Save per year	Energy	CO2
Trucking company	$ 20 million	20 kilotons
Trucking industry	$ 0.2 trillion	0.2 Gigatons
All world machines	$ 1.8 trillion	2.3 Gigatons

Car makers: *"Kill for 0.5% efficiency gain"*

EV buyers: *"Range anxiety is no.1 concern"*

We give extra 8%

Reduce CO2 emission by 6%

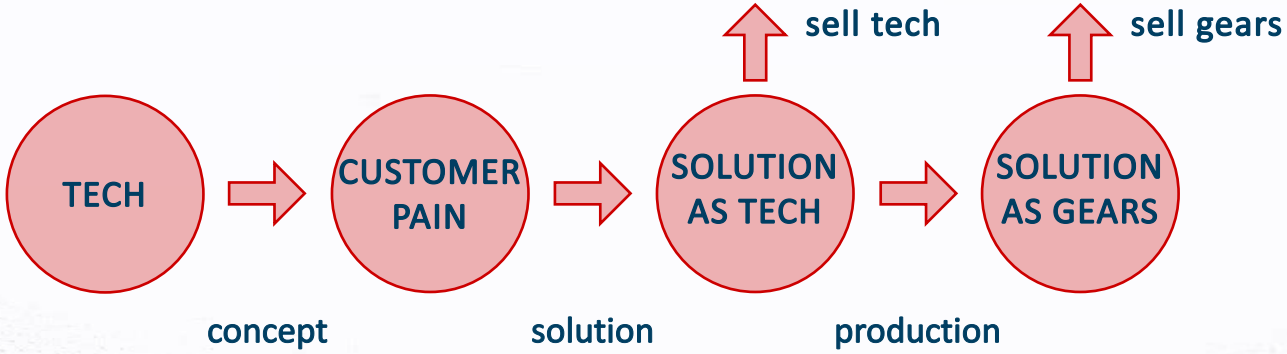
Go to market: innovate for customers

Sell innovation:

Provide new solutions for customer pain
Technology: sell solution as tech (license)
Production: sell solution as gears (hardware)

Collaborate to innovate:

Contact >> collaborate >> find solution
Maintain partnership, support, follow up
Transfer-fee pricing for first adopters



Selected customer projects

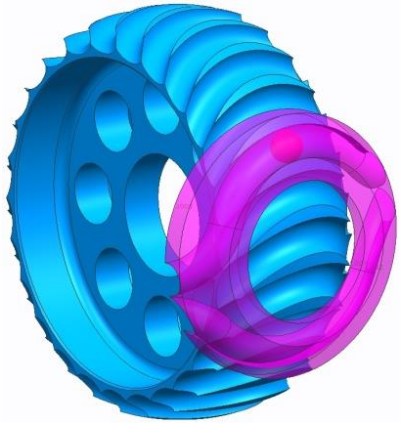
Electric car gear: 3 EU + 1 US customer

click picture for movie

TOOTH GEAR:

must have
2 stages (4 wheels)

Due to high-rpm electric motors, EV gears must have high gearing ratios min. 10-18



SINCROLL GEAR:

easy with
1 stage (2 wheels)

With 1 stage, we reduce:

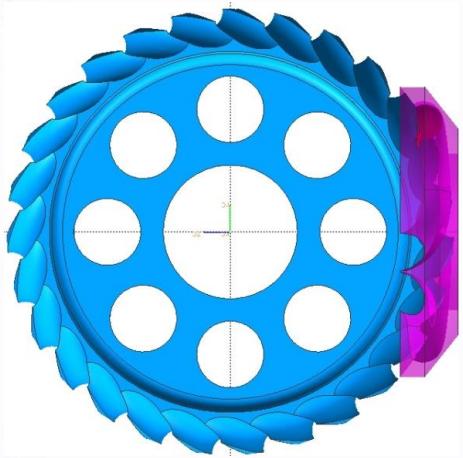
- volume/weight
- no. of parts
- costs
- energy losses (even higher efficiency)

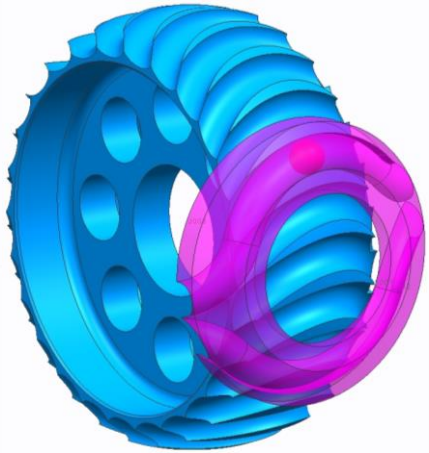
sincroll gears make high ratios up to 60 in 1 stage for any axis setup - key for all electrification

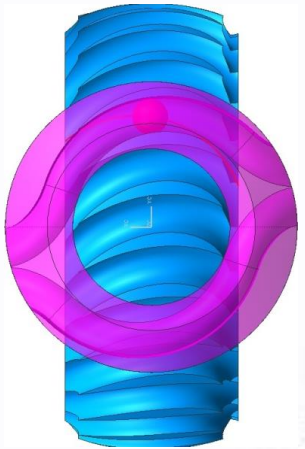
Electric car gear: 3 EU + 1 US customer

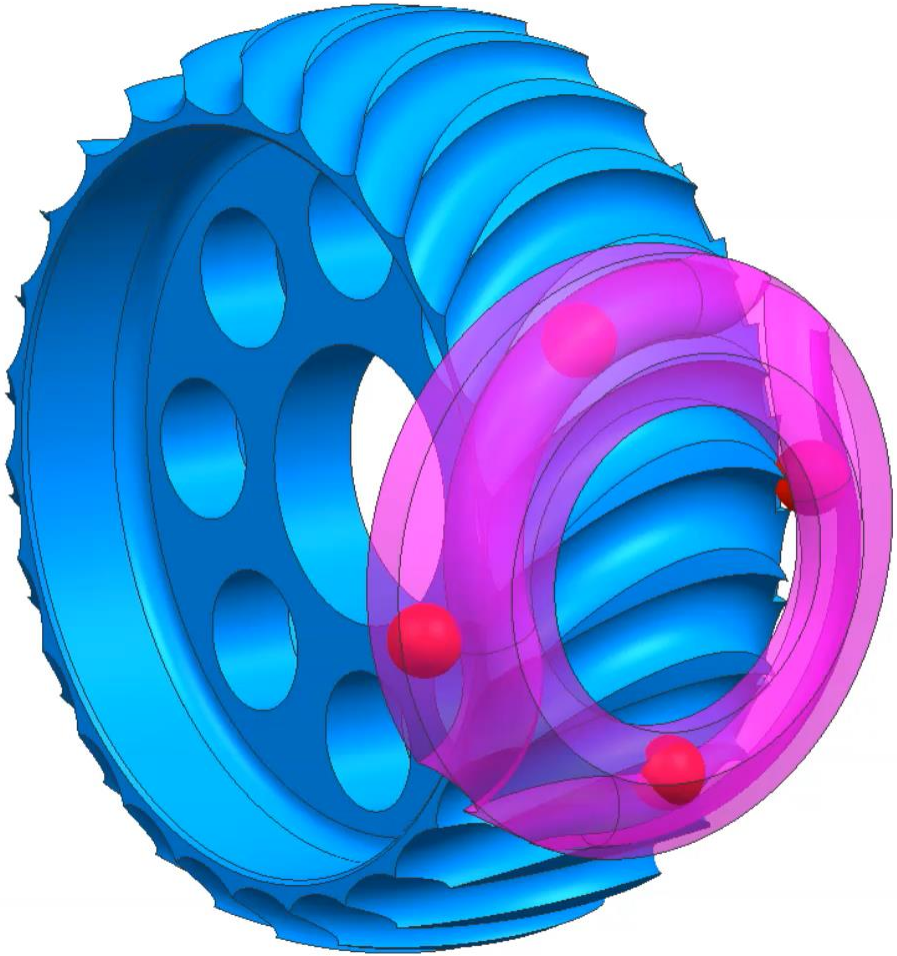
click pictures for movie

CONCEPT









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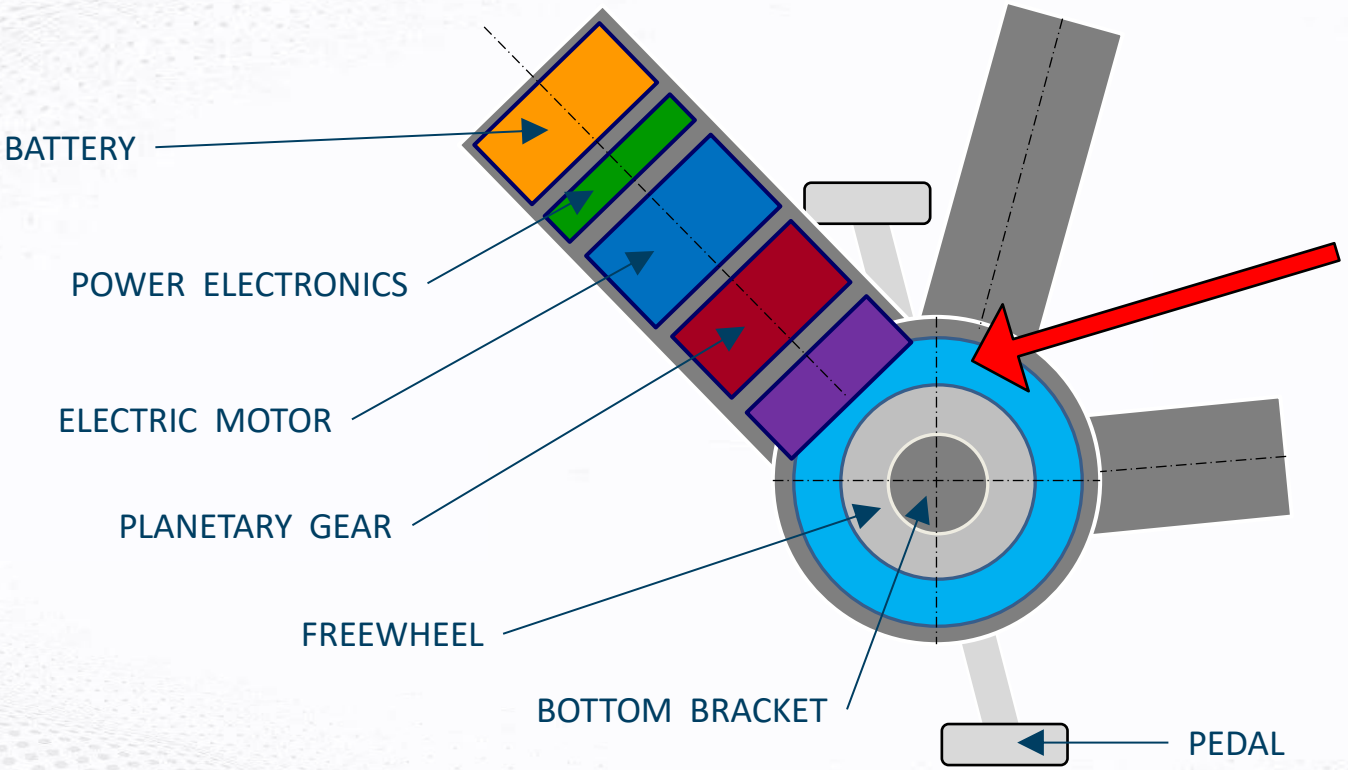
Electric bike gear: Hungarian customer



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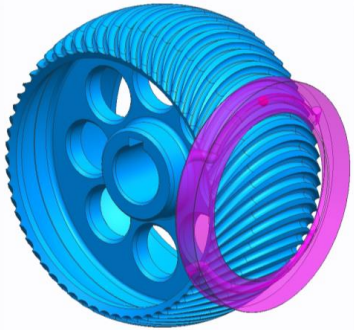
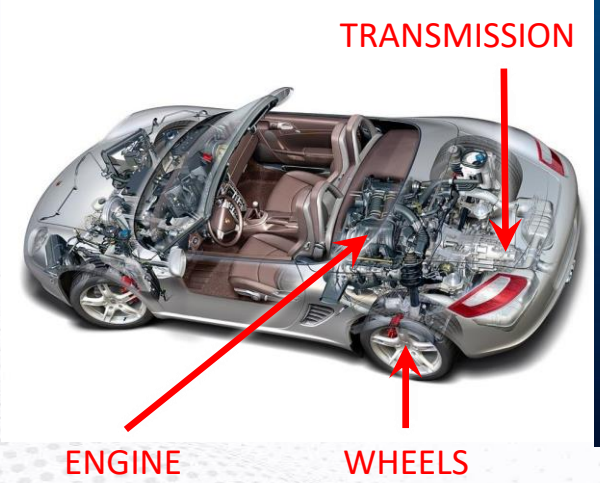


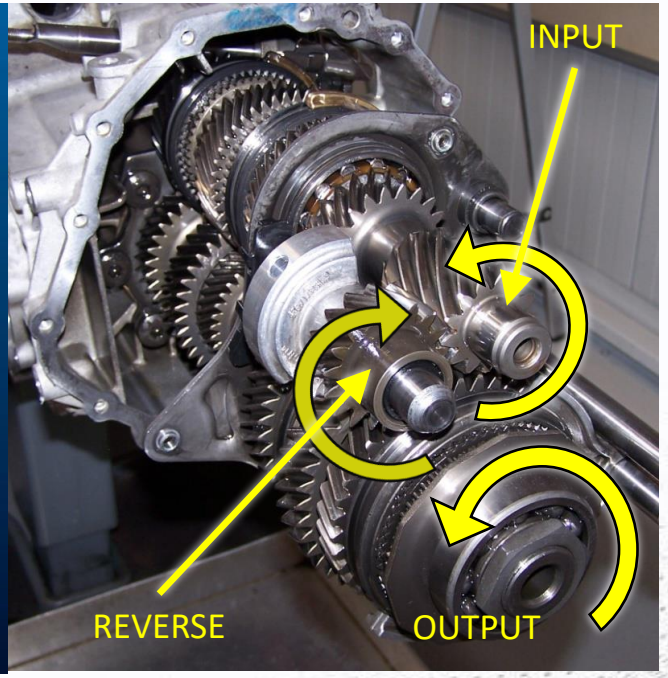
SINCROLL GEAR

Car transmission reverse shift gear: EU customer

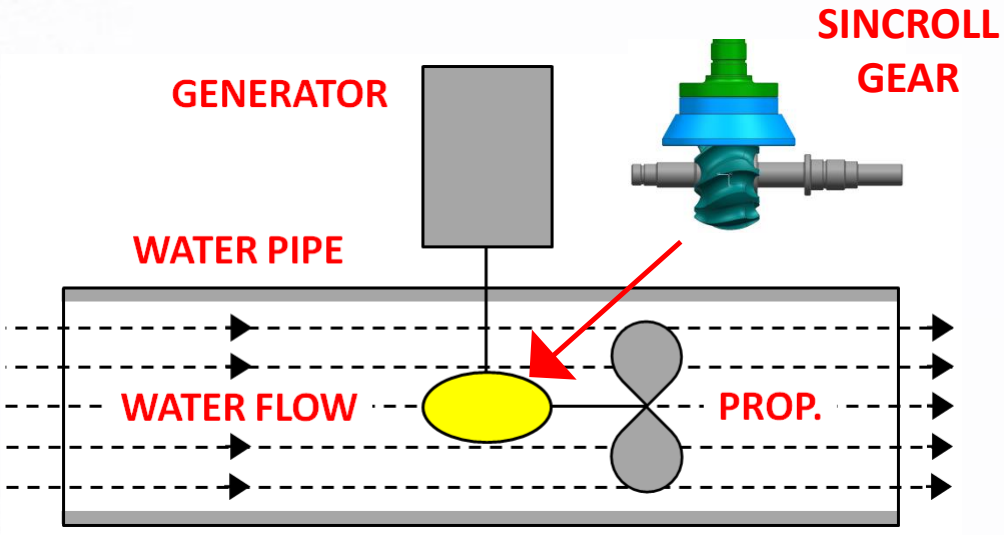
SINCROLL GEAR

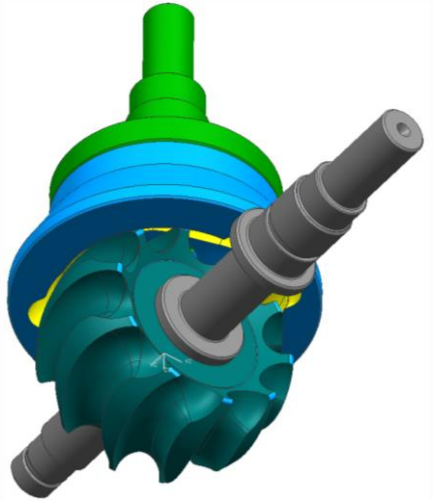
CAR TRANSMISSION





In-pipe water turbine: Hungarian customers



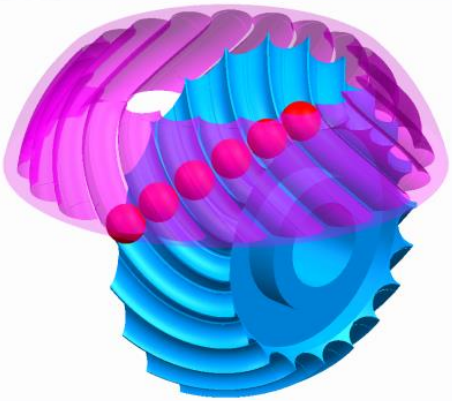


SINCROLL GEARBOX

Marine winch gear: US customer

click pictures for movies

CONCEPT



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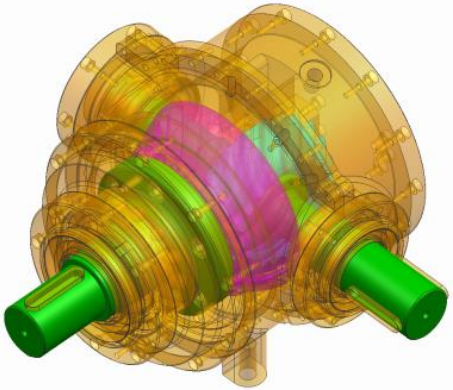
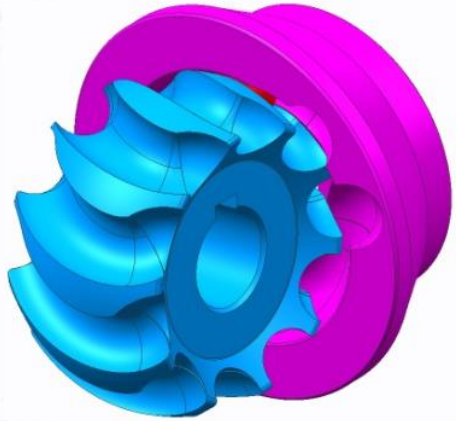


PROTOTYPE

Machine tools gear: Hungarian customer

click pictures for movies

CONCEPT



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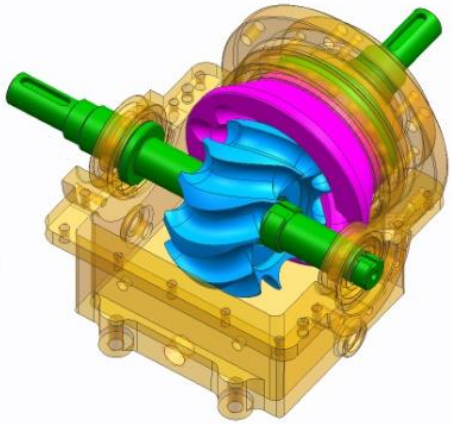
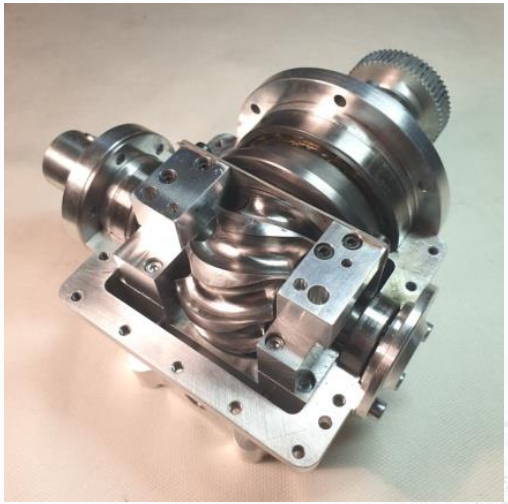


PROTOTYPE



Testing TRL6

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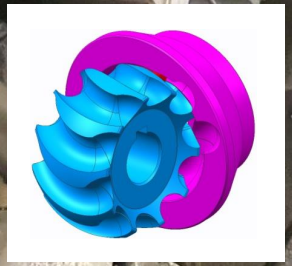
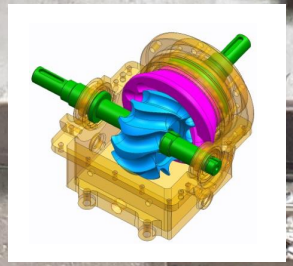
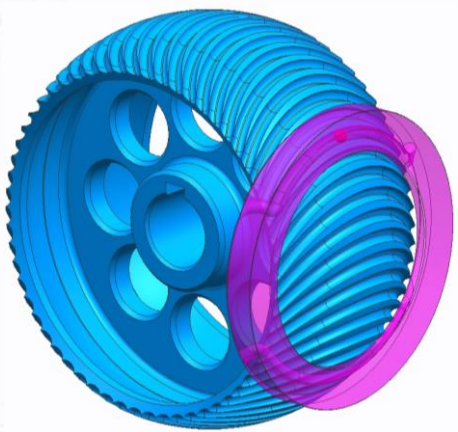




Robot arm gear: US customer

click pictures for movies

CONCEPT



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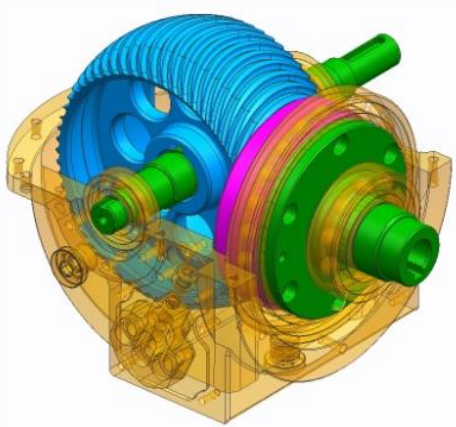

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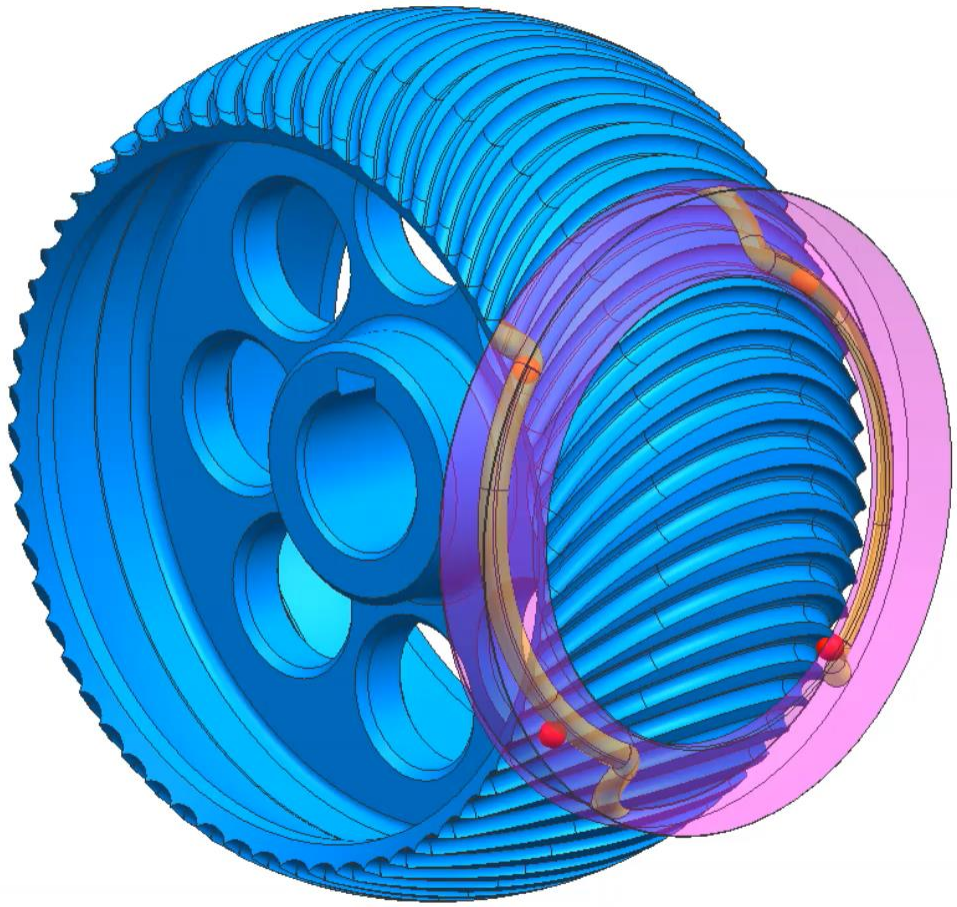
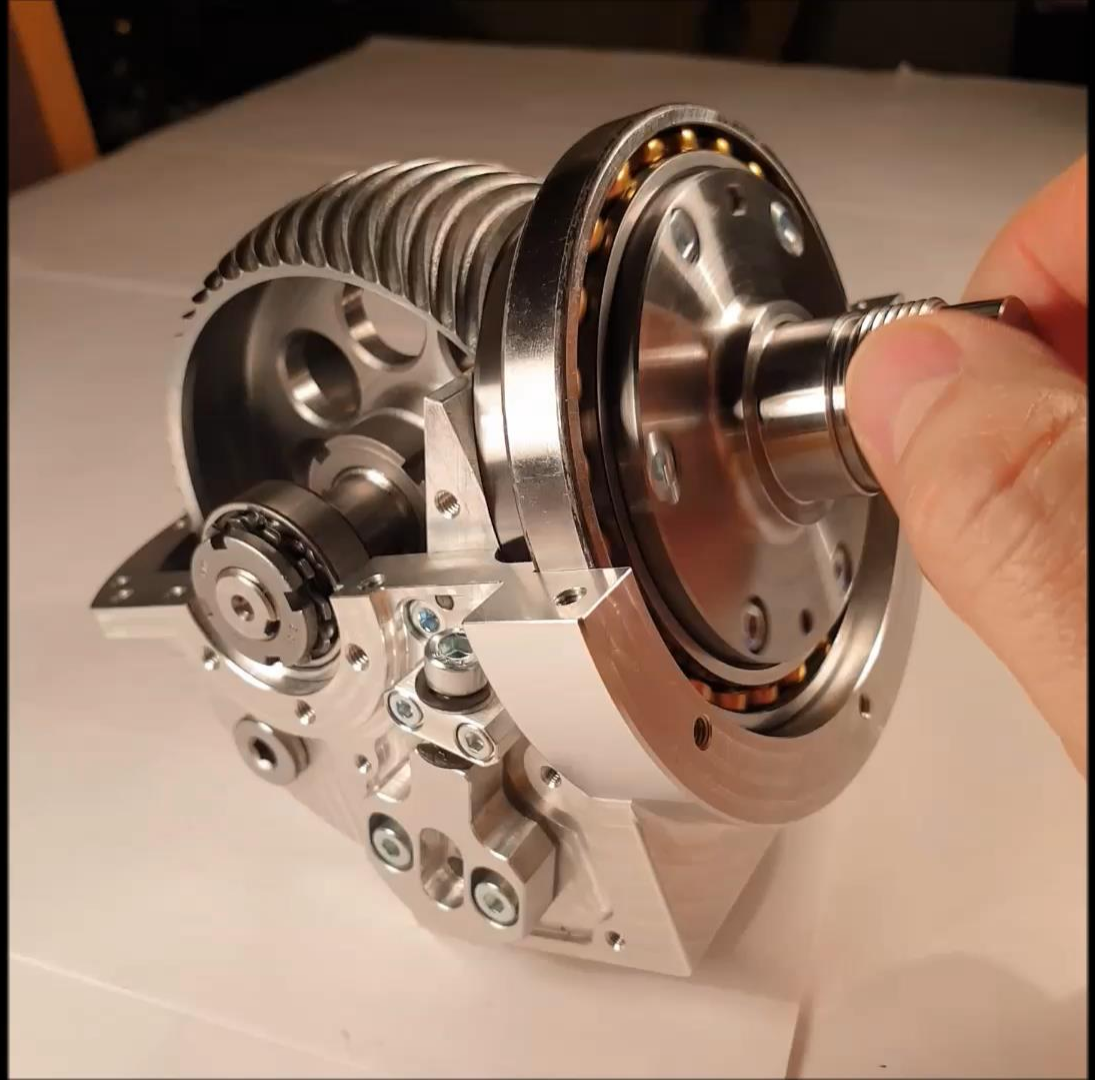


TFR-TRI WORK Camera TFR-TRI



Appendix

Selected internal prototypes & tests

Various plastic demos

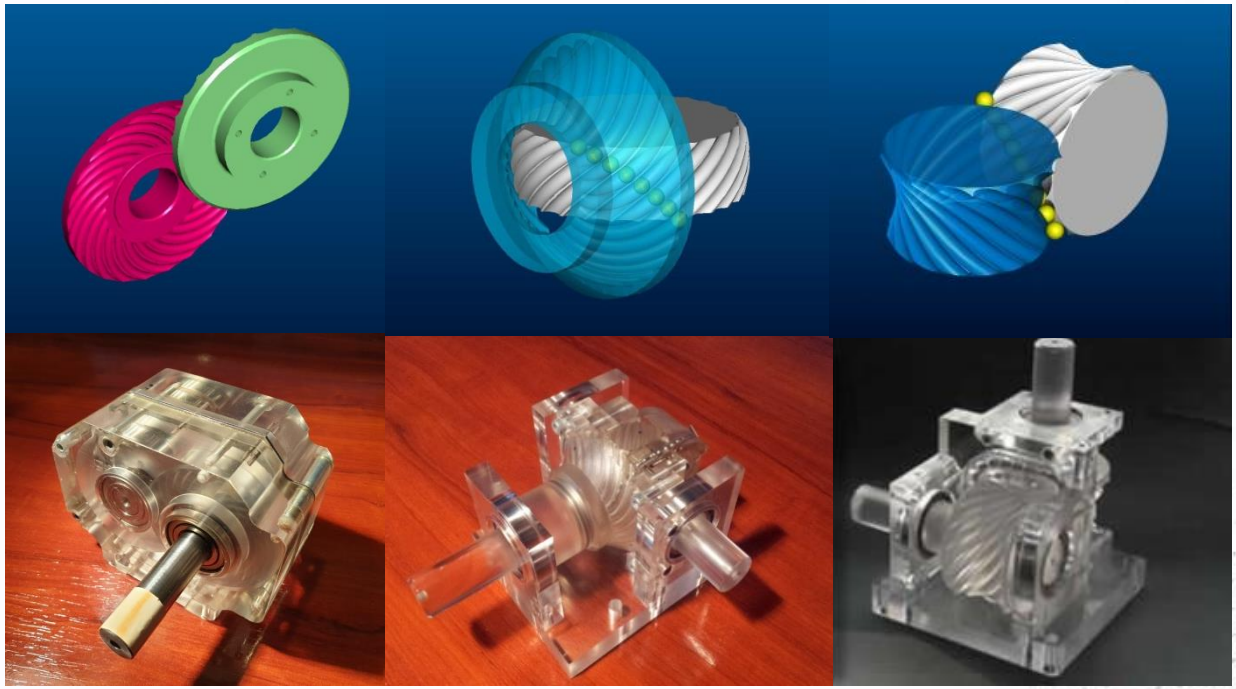
click pictures for movie

Gearing ratios 1 for all

Axis geometry:

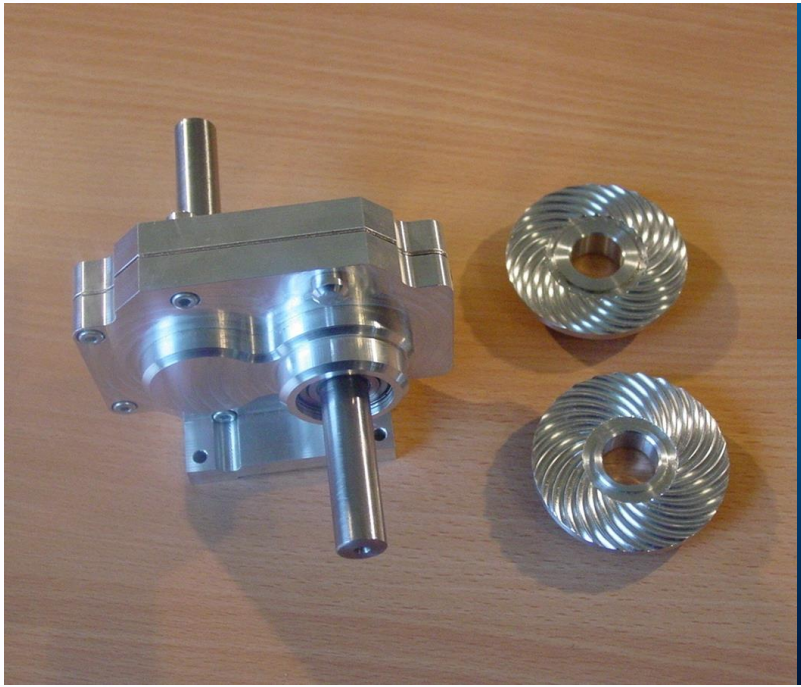
- parallel axes
- 90-degree crossing
- 90-degree offset

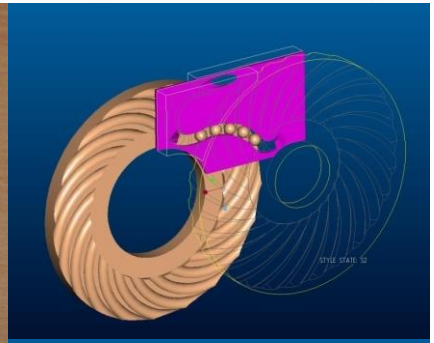
Material: plastic

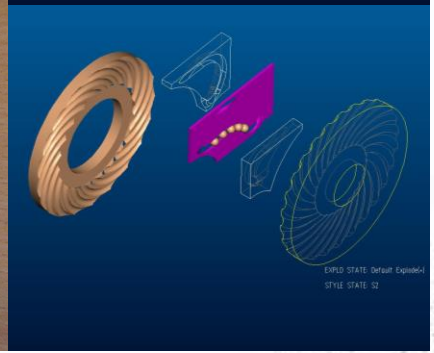


Parallel axes gear

Gearing ratio 26/23
Axis angle: parallel
Axis offset: 38.5 mm
Wheels: 60 x 60 mm
Ball diam.: 4.0 mm
Contact factor: 5
Material: Aluminium



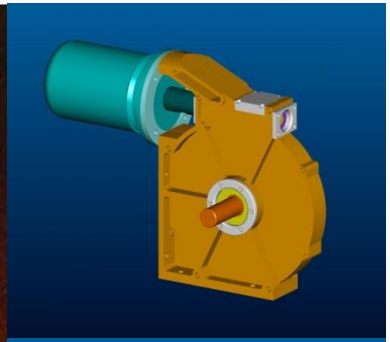


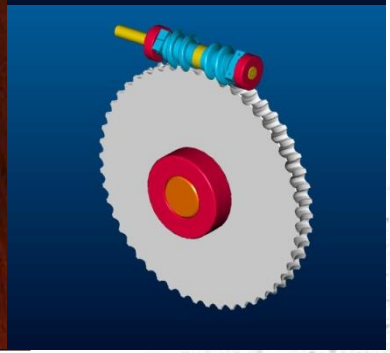


Ratio-50 90-degree offset axes gear

click pictures for movie

Gearing ratio 50
Axis angle: 90^{o}
Axis offset: 145 mm
Wheels: 15 x 260 mm
Ball diam.: 4.0 mm
Contact factor: 3
Material: steel

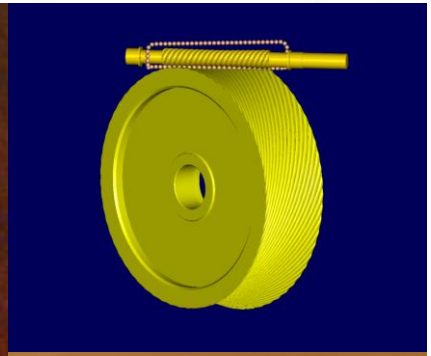




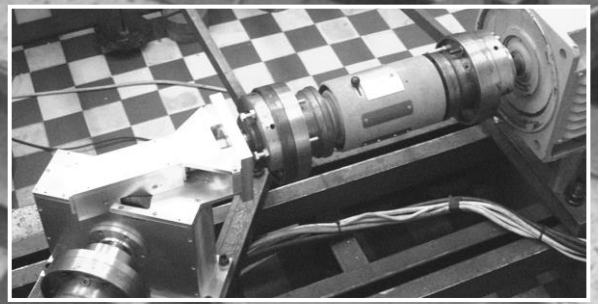
45-degree offset axes gear

click pictures for movie

Gearing ratio 10
Axis angle: 45°
Axis offset: 130 mm
Wheels: 15 x 230 mm
Ball diam.: 4.0 mm
Contact factor: 22
Material: steel

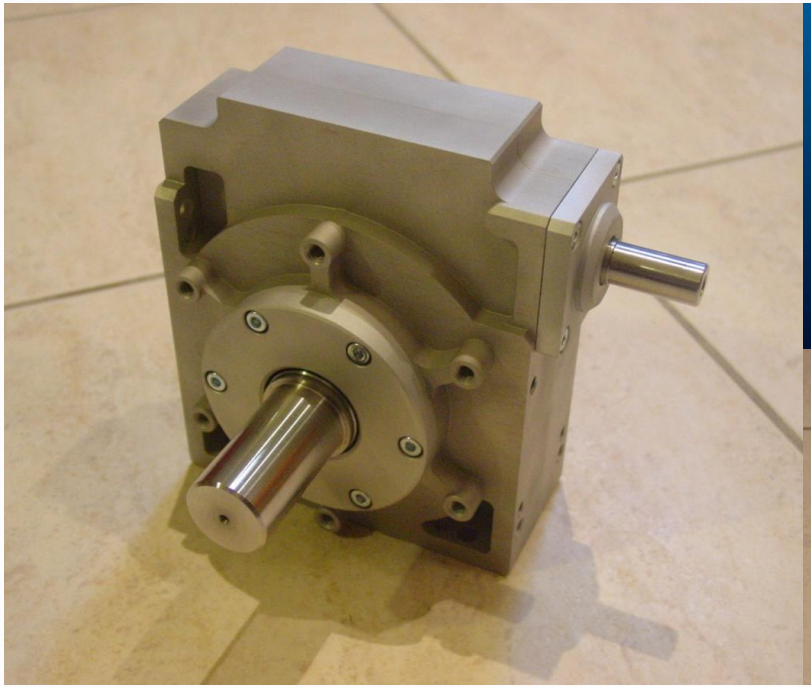


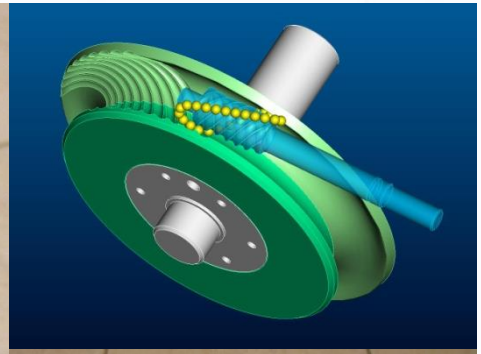
Testing TRL5



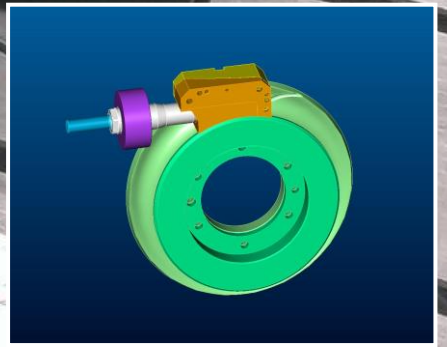
Ratio-10 90-degree offset axes gear (rotary table)

Gearing ratio 10
Axis angle: 90^{o}
Axis offset: 50 mm
Wheels: 15 x 130 mm
Ball diam.: 4.0 mm
Contact factor: 6
Material: steel





Testing TRL5

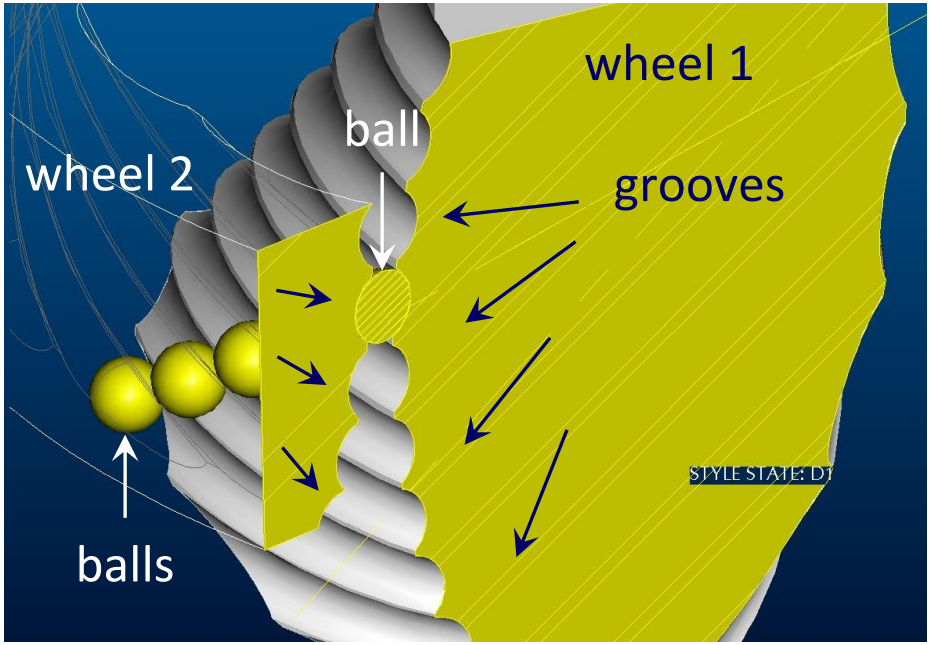


Appendix

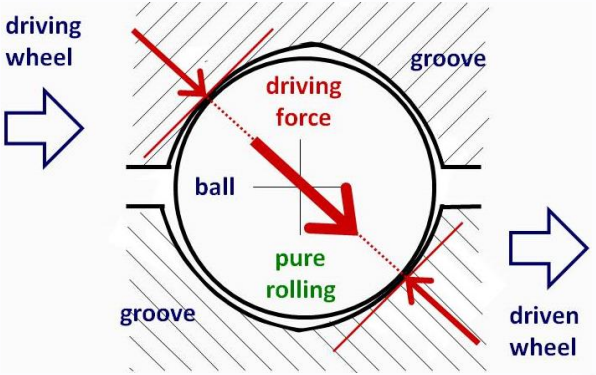
Further technical insights

Bearings for gearing

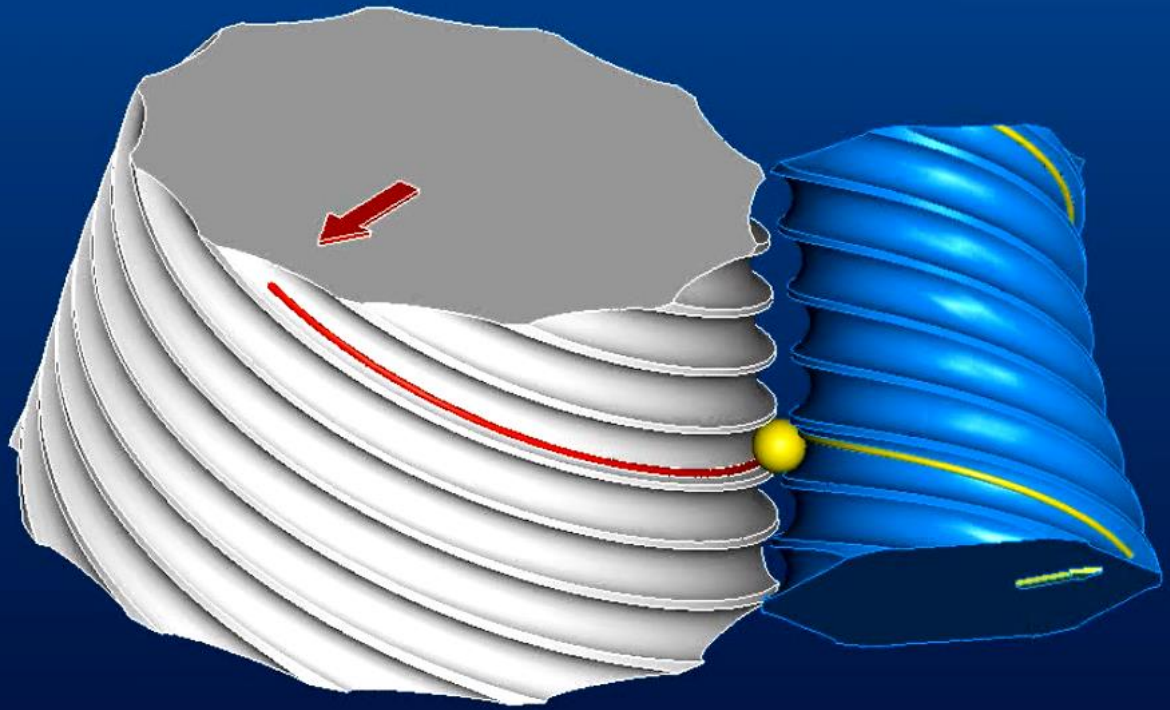
Paradigm shift in gear technology

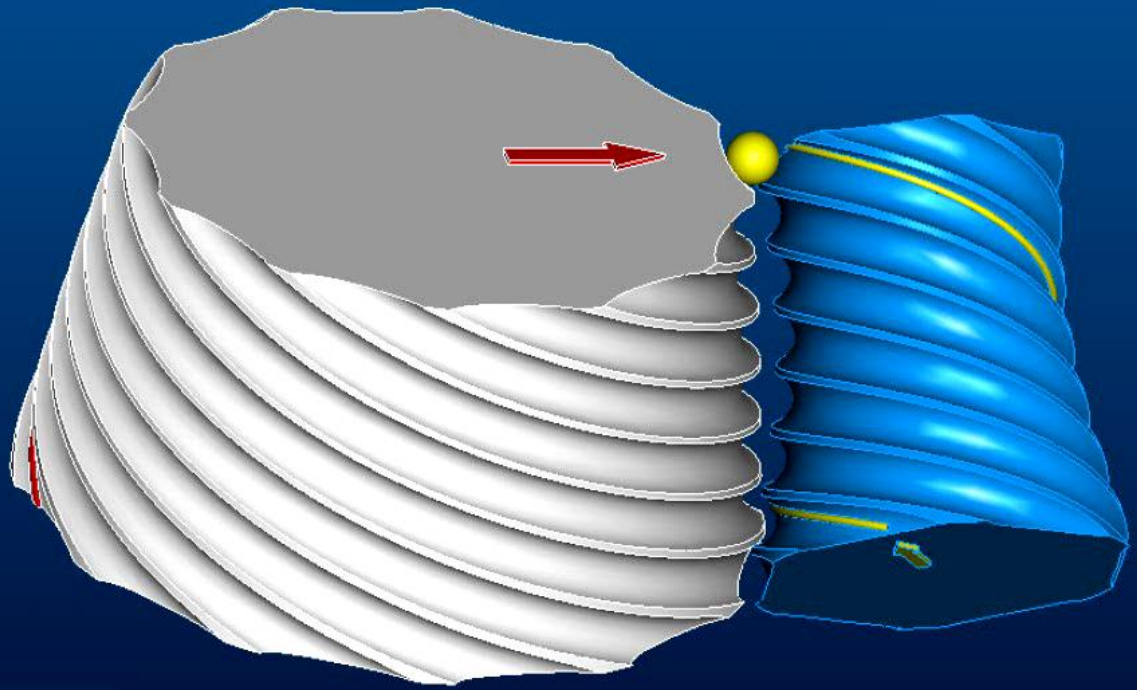


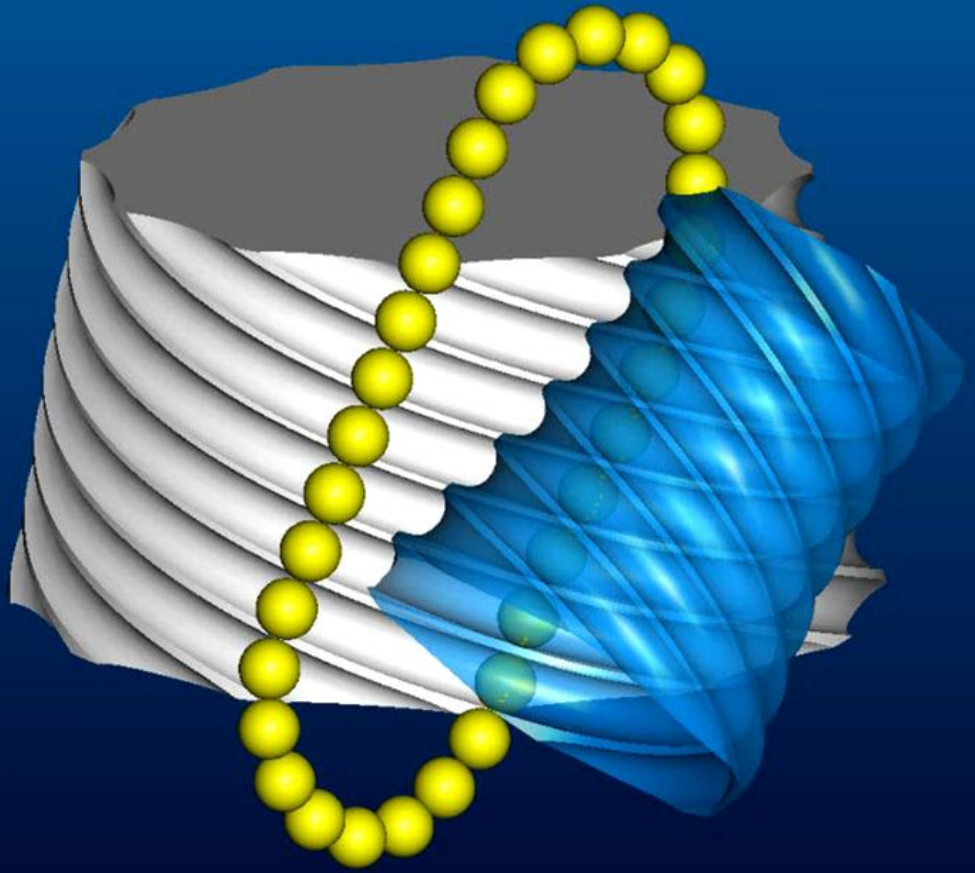
gear wheels coupled by balls
rolling along grooves on the wheels
with fundamentally zero friction



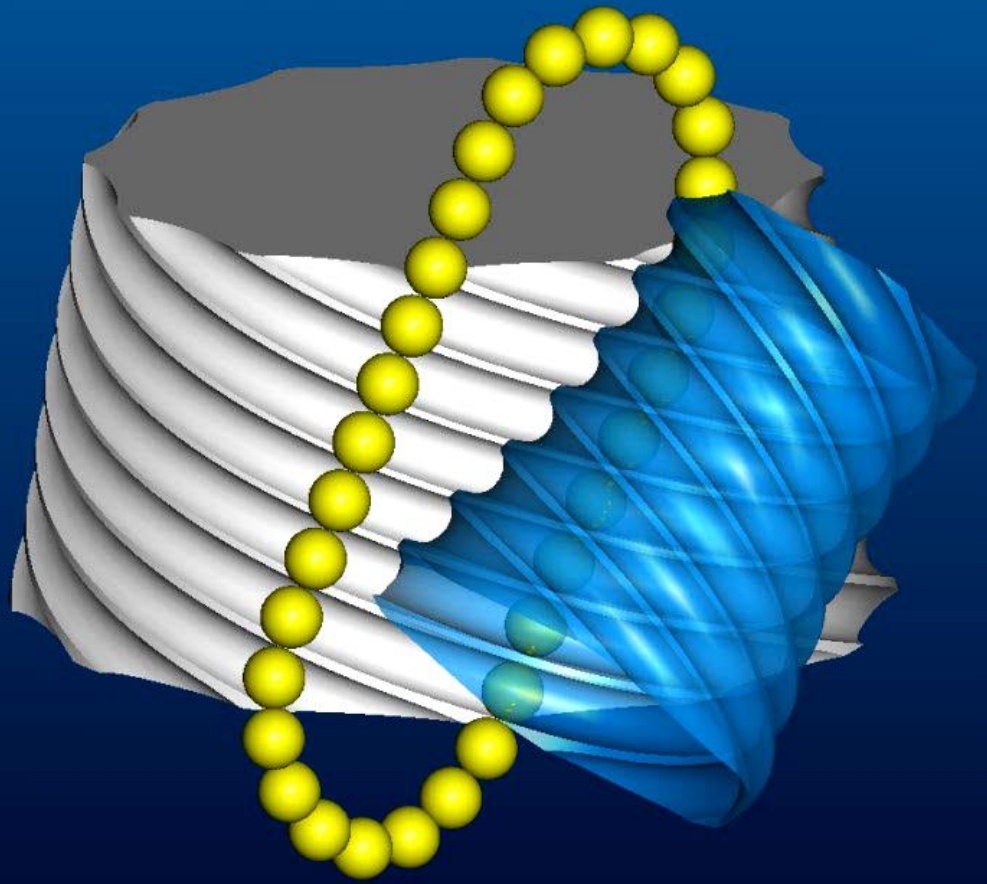
click picture for movie





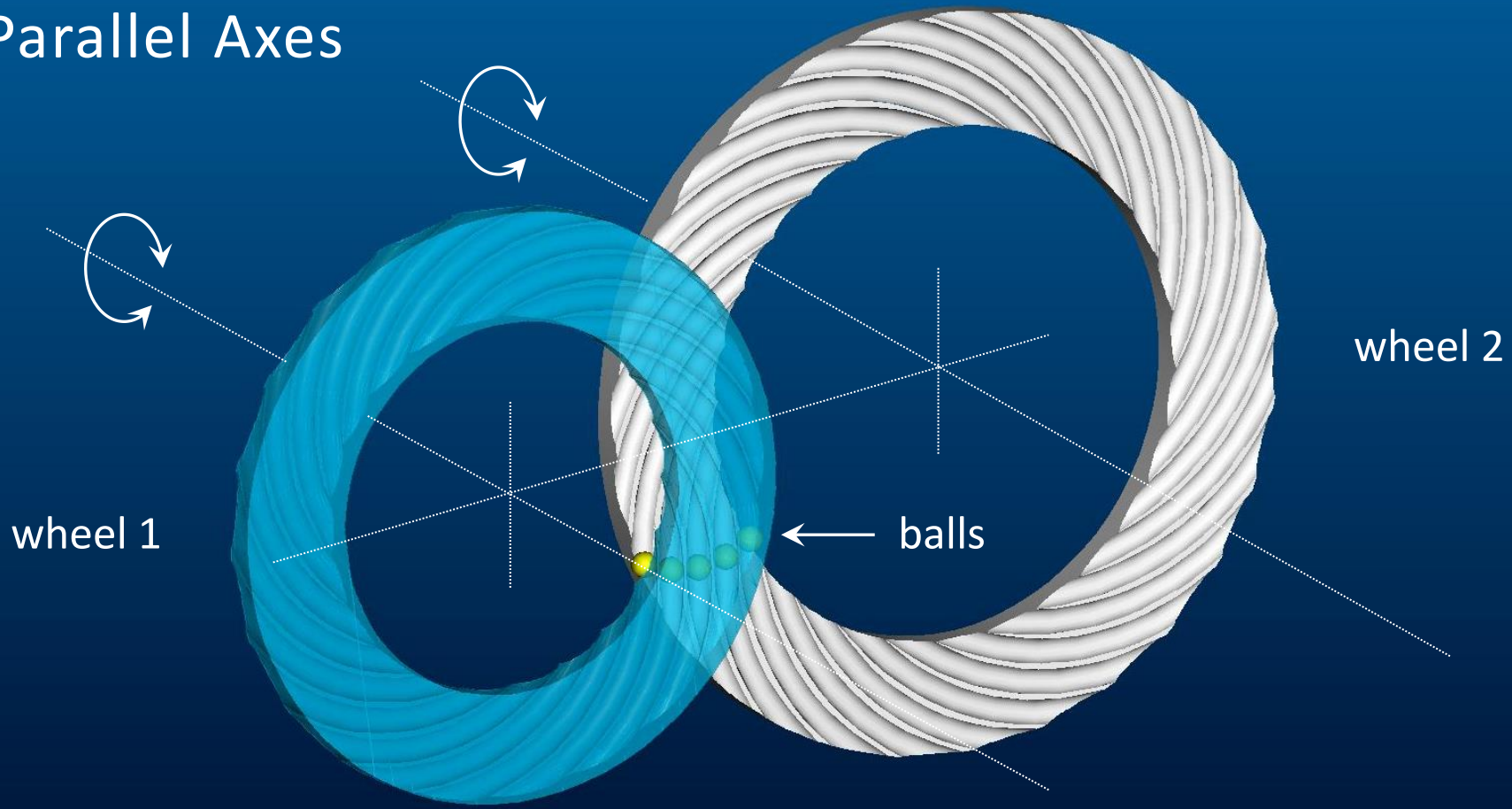


click picture for movie



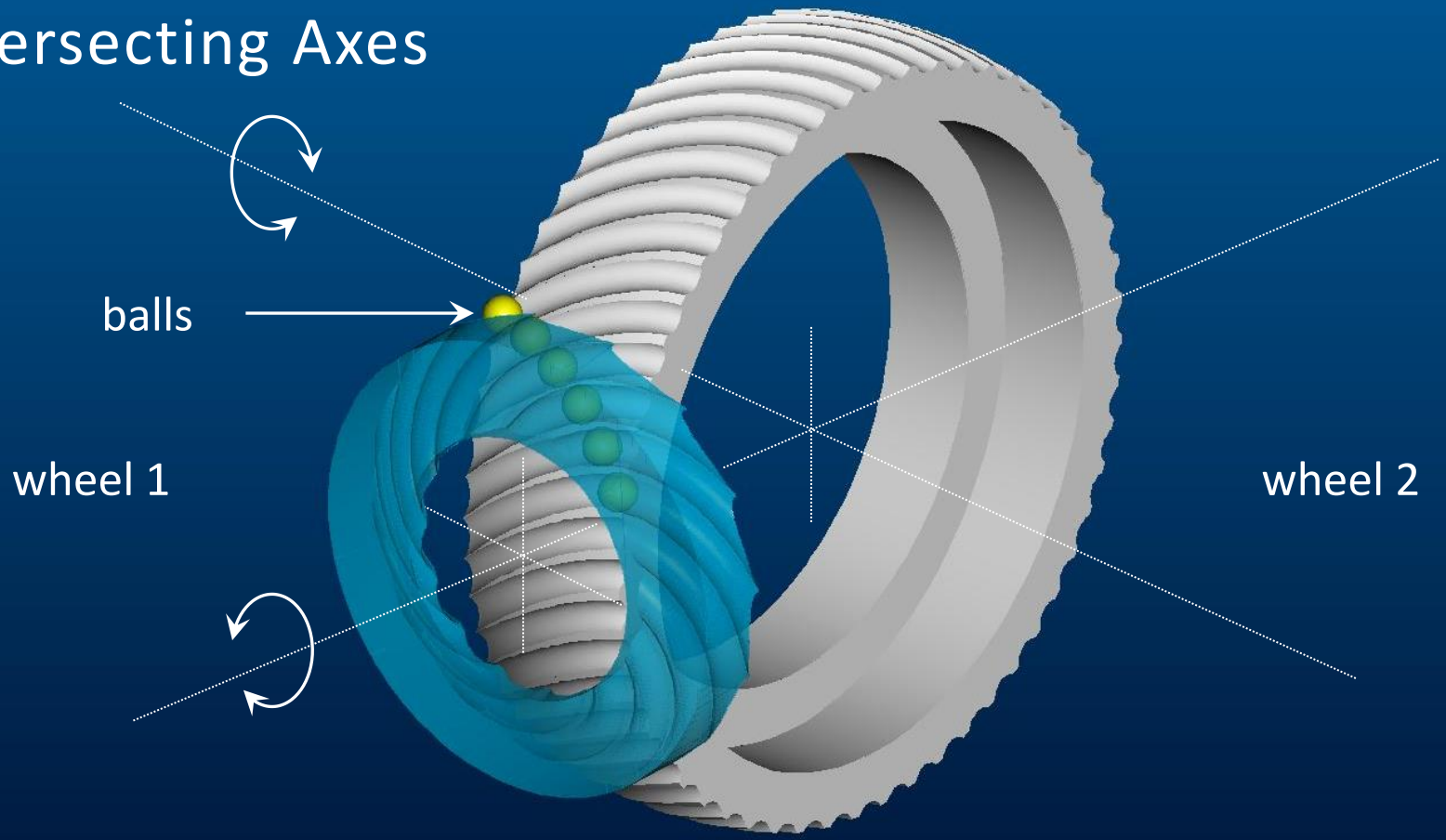
Principal Designs

Parallel Axes



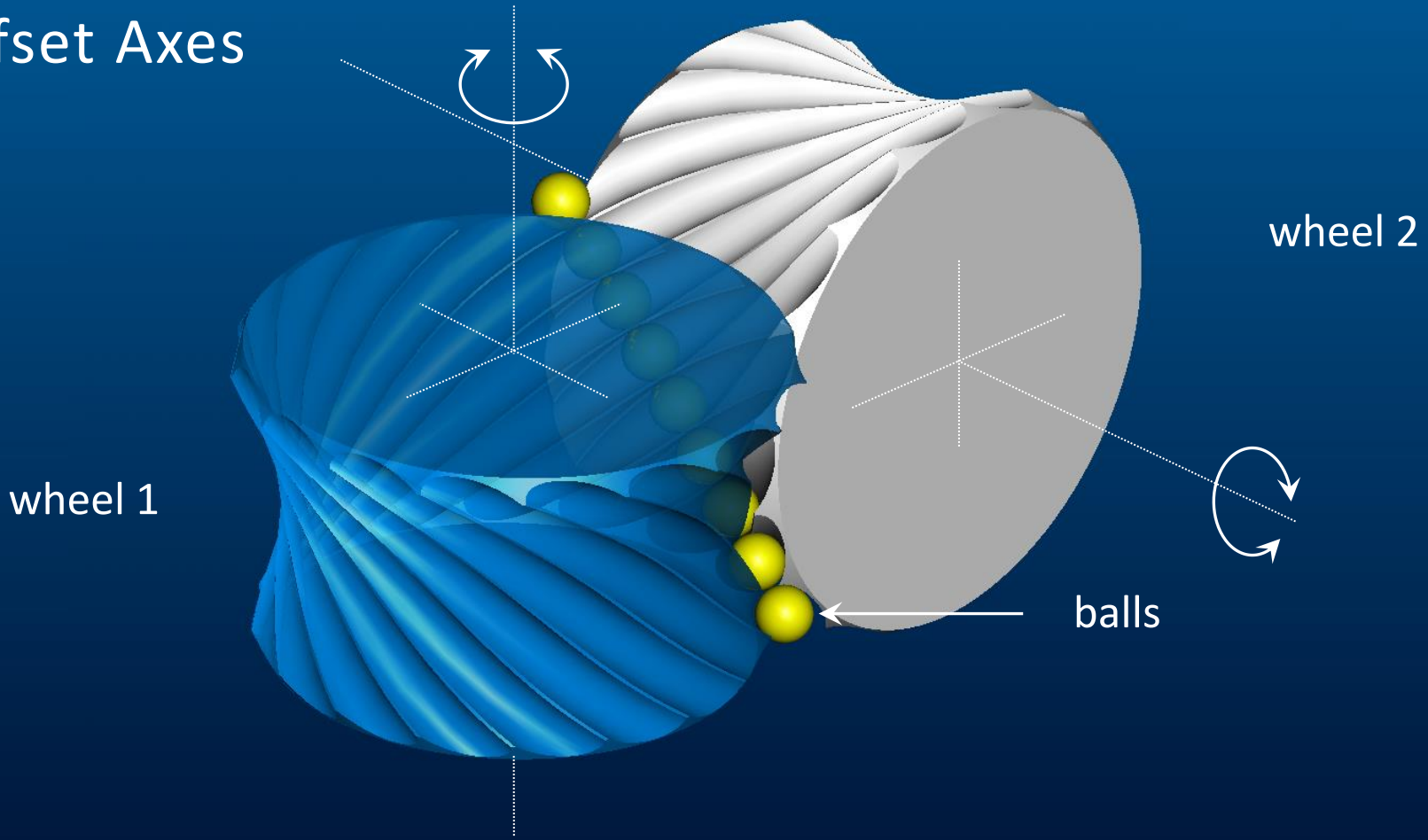
Principal Designs

Intersecting Axes



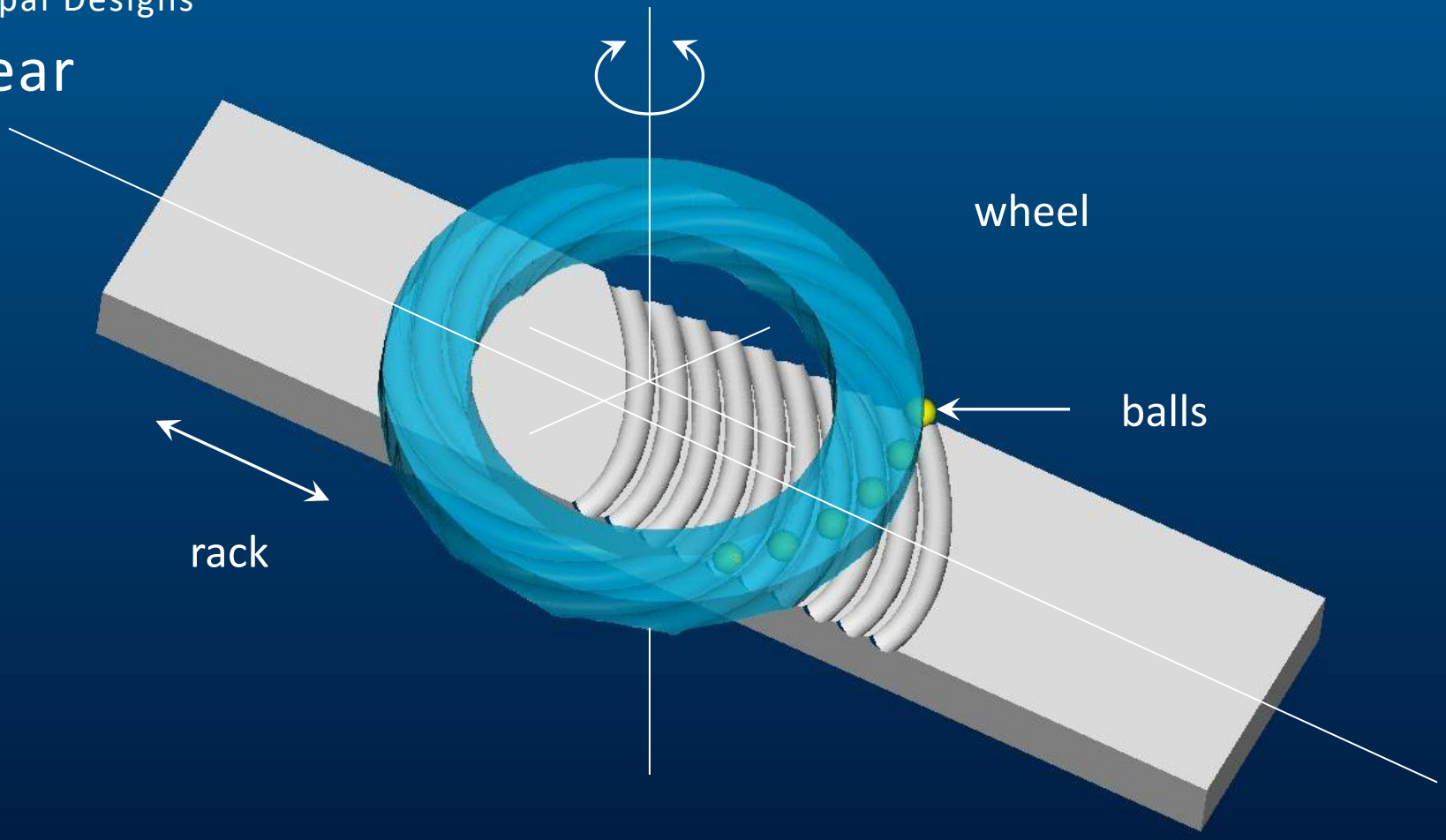
Principal Designs

Offset Axes



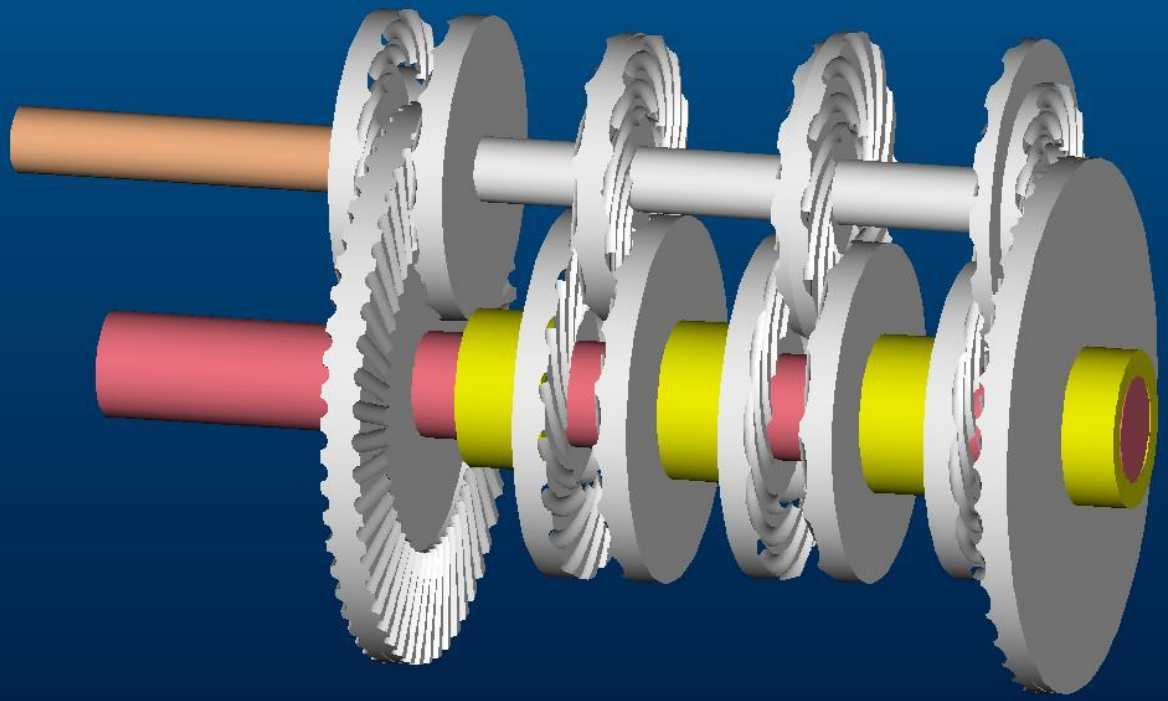
Principal Designs

Linear



Complex systems

Full car transmission (Porsche)



Advantages

Advantages

- Universally applicable in entire $ 200 billion gear market: all specifications, all applications, all industries
- Fundamentally zero friction & perfect 100% efficiency: save energy & CO2 emission (up to 70%) little wear & abrasion, long life, no stick/slip
- High gearing ratios (up to 60), small centre distances: small size & weight, simple design, low price
- No backlash, eliminated by preloading, no jamming: low noise, high precision
- Haptic & backdrivable features, force feedback (robots)
- Large contact factor (up to 20 balls)
- Arbitrary direction of rotation
- Little lubrication & maintenance, robust
- Can monitor, manipulate or change balls real time
- Large variety of designs for each specs, design flexibility

Applications

- All vehicles including ground, air, water & space: cars, trucks/buses, trains, bikes, off-road, UGVs, ships, boats, submarines, UWVs, airplanes, helicopters, drones (UAVs), flight controls, radars, space vehicles
- Agro, construction, building, mining & chemical machines: lifts, conveyors, escalators, cranes, crushers, drills, mixers, grinders, loaders, mills, mowers, ropeways, swathers
- Industrial machines, factory equipment, production lines
- Machine tools: rotary tables, spindles, driven tool holders
- Precision machines
- Robots & automation
- Energy industries: power plants, water & wind turbines
- High vacuum & ultra clean environment
- Plastic equipment such as kitchen appliances
- Watches & clocks
- Wood industries

Comparable advantages

SINCROLL	TOOTH GEARS
99+ % EFFICIENCY all geometries, all ratios, always less abrasion, wear, heat, noise, longer life	30-95% EFFICIENCY depending on geometry, gearing ratio loss of energy/CO2, bad performance
NO BACK-LASH, HIGH PRECISION less noise, smoother run, longer life	HARD TO REDUCE BACKLASH jamming
HIGH GEARING RATIOS, UP TO 60 smaller size, simpler design	LOW GEARING RATIOS, UP TO 6-8 bigger size, more complex design
SMALL AXIS DISTANCE down to a few mm’s	LARGE AXIS DISTANCE tens of mm’s ad minimum
COMPLEX KNOW-HOW difficult to reverse engineer	WELL KNOWN TECHNOLOGY open, widely known, commodity
PATENTS IN 13 COUNTRIES further new know-how & patents coming	NO PROTECTION no further tech advances

More comparable advantages

SINCROLL	TOOTH GEARS
BACKDRIVABLE no self-locking, yes force feedback haptic movement robots & (flight) controls	NOT BACKDRIVABLE self-locking at high ratios need extra sensors for force feedback
ARBITRARY ROTATION DIRECTION save extra shaft, size, weight, complexity	ONLY OPPOSITE DIRECTION need extra shaft to change direction
HIGH COUPLING NUMBER up to 20 balls tested in prototypes	LOW COUPLING NUMBER 1.5-2.5 teeth
RICH, ROBUST & FLEXIBLE DESIGN many solutions for one specs, optimisable	INFLEXIBLE DESIGN one solution for one specs
LESS LUBRICATION, CLEAN clean environment & vacuum	MORE LUBRICATION dirt, cost, complexity, sealing
BALLS SEPARATE OBJECTS manipulated, changed, cooled etc outside	TEETH FIXED TO WHEELS inseparable, constrained

Appendix

Gears basics

State of the art tooth gears

What gears do

EXAMPLES	MOTOR	GEAR	APPLICATION
BMW 320i	engine 4,500 rpm torque 270 Nm	gear ratio 3.1 power 127 kW (170 LE)	wheel 1,450 rpm (180 km/h) torque 840 Nm
Porsche 911	engine 6,000 rpm torque 730 Nm	gear ratio 3.2 power 458 kW (615 LE)	wheel 1,896 rpm (250 km/h) torque 2,310 Nm
helicopter	engine 2,700 rpm torque 5,000 Nm	gear ratio 6 power 1,410 kW	rotor 450 rpm torque 30,000 Nm
wind turbine	generator 1500 rpm torque 20,000 Nm	gear ratio 100 power 3,140 kW	rotor 15 rpm torque 2,000,000 Nm
ship	engine 720 rpm torque 66,400 Nm	gear ratio 4.8 power 5,000 kW	propeller 150 rpm torque 319,000 Nm

Where gears are used