AUTODESK. UNIVERSITY

How to lead multi functional engineers over Fusion Teams with Fusion 360

Hiroto Hamane

Professor | @kogakuin university

Speaker

Prof. Hiroto Hamane (Kogakuin University)

Dept. of Mechanical Systems Engineering, Kogakuin University.

Director of Kogakuin University Solar Team.

He founded Kogakuin University solar team in 2009. The team is winning four consecutive solar car races in Japan. The team has the highest record of driving the longest distance in energy saving in a historic Japanese race for about 30 years. The team also participates in the world's largest solar car race in Australia. In 2015, the team won second place in the cruiser class. In 2019, the team won the Technical Innovation Award from CISRO for the first time in Japan. The team's vehicles are unique and focused on biomimetics technology.

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Agenda

TEAM MANAGEMENT WITH FUSION 360

- Introducing “Kogakuin University Solar Team”
- The race : Bridgestone World Solar Challenge
- Demonstrates “Team management with Fusion 360”

SOLAR VEHICLE DESIGN SAMPLES

- Fusion 360 Simulations (FEM)
- Fusion 360 + Autodesk CFD
- Generative Design
- CAM

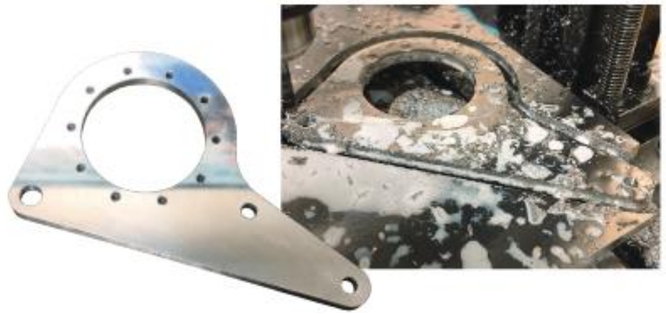
AUTODESK®
FUSION 360

Generative Design 89% lighter

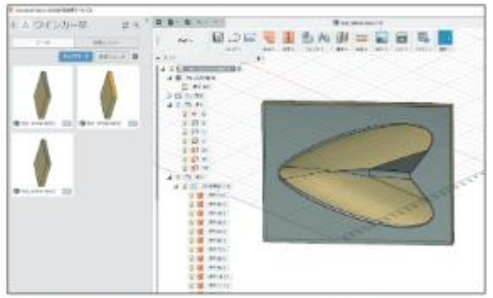
●パーツ軽量化

CAM 1/13 time reduction

●オリジナル金属パーツの切削



Team management, Data migration



Rendering

KOGAKUIN Solar Team

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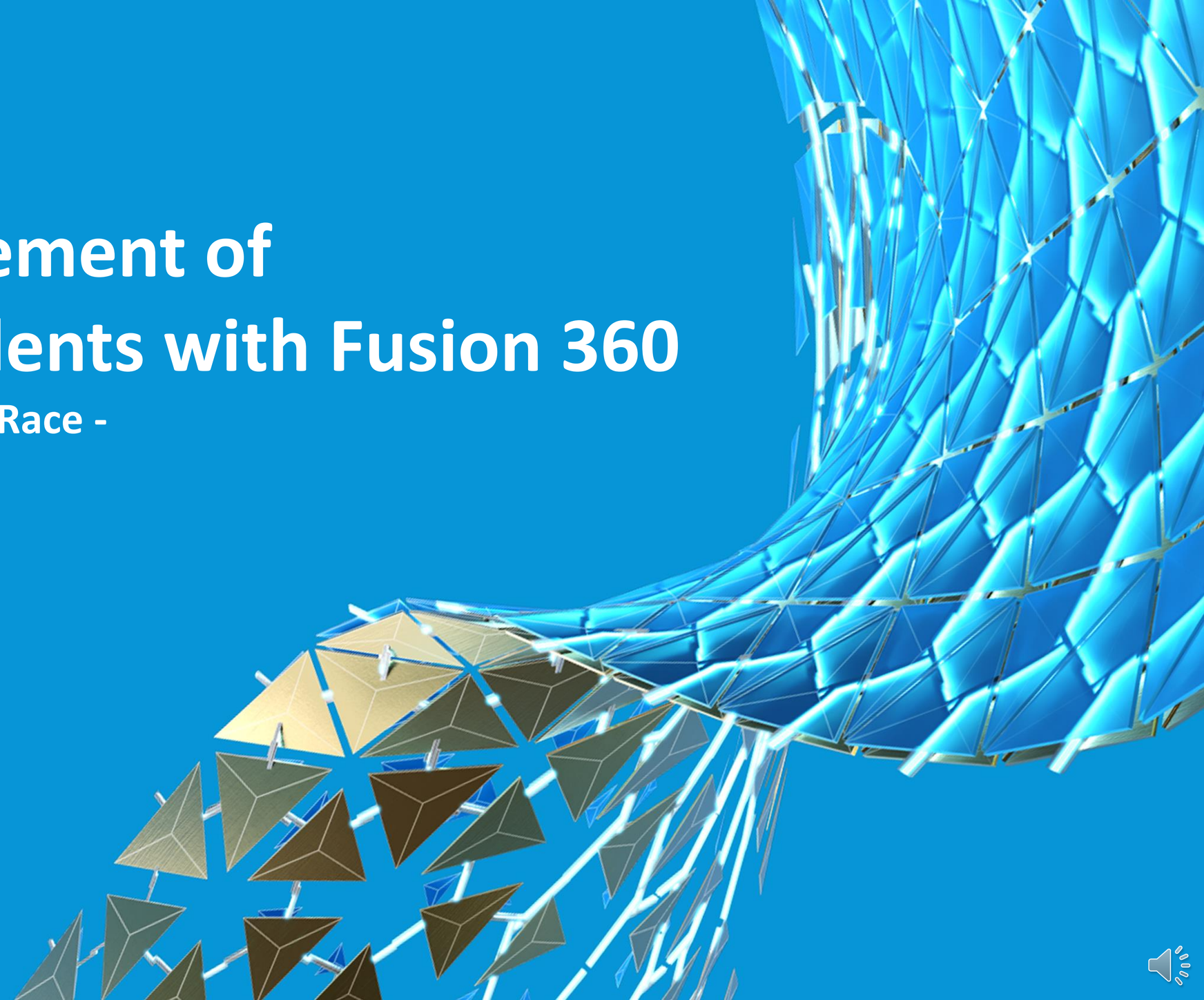
Team management of over 300 students with Fusion 360

- Introducing Team and Race -



Bridgestone World Solar Challenge (BWSC)

The BWSC take place once **every two years**. In **2017**, the race celebrated its **30th Anniversary**.

BRIDGESTONE WORLD SOLAR CHALLENGE

Innovation

Passion

Adventure

Environment

Sustainable society

《Competition Details》

Bridgestone World Solar Challenge

Australia from Darwin to Adelaide, 3000km

Date： October, every two years

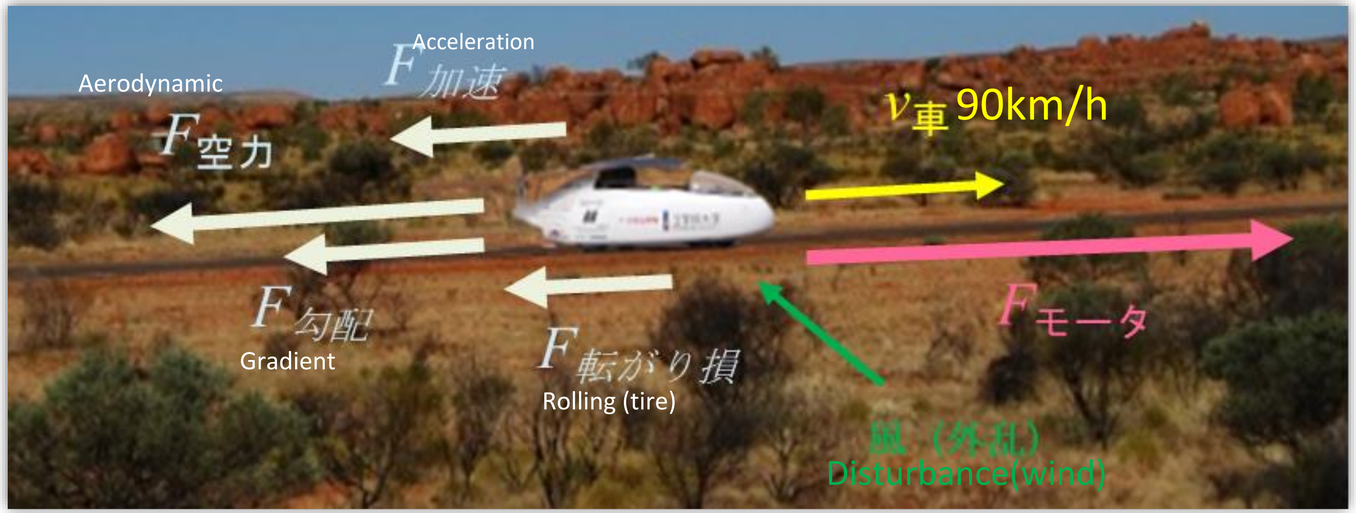
Organizer：South Australian Tourism Commission

Only 1000W solar panel

All other energy must come from the sun or be recovered from the kinetic energy of the vehicle.
A 5kw battery of stored energy is only **10% of total energy for the race**.

Q: How many kilogram-force does the total running load balance when traveling at 90 km / h?

A: 30N (3Kgf) at 90km/h



$$F_{motor} = F_{aero} + F_{Roll} + F_{Grad} + F_{acce}$$

Aero: Aerodynamic, Roll : Rolling (tire)
Grad: Gradient, Acce: Acceleration

What kind of running noise do you hear?

The running noise is very quiet.
You can only hear the tire noise.
Aerodynamics is the dominant factor for solar cars.

Only One Design

The team prohibits imitation of past cars. Team member have to consider the new concept.

Even though we imitate the 16th century idea,
we can not develop the next generation technology

The first car (2009)

The second car (2013)

The third car (2015)

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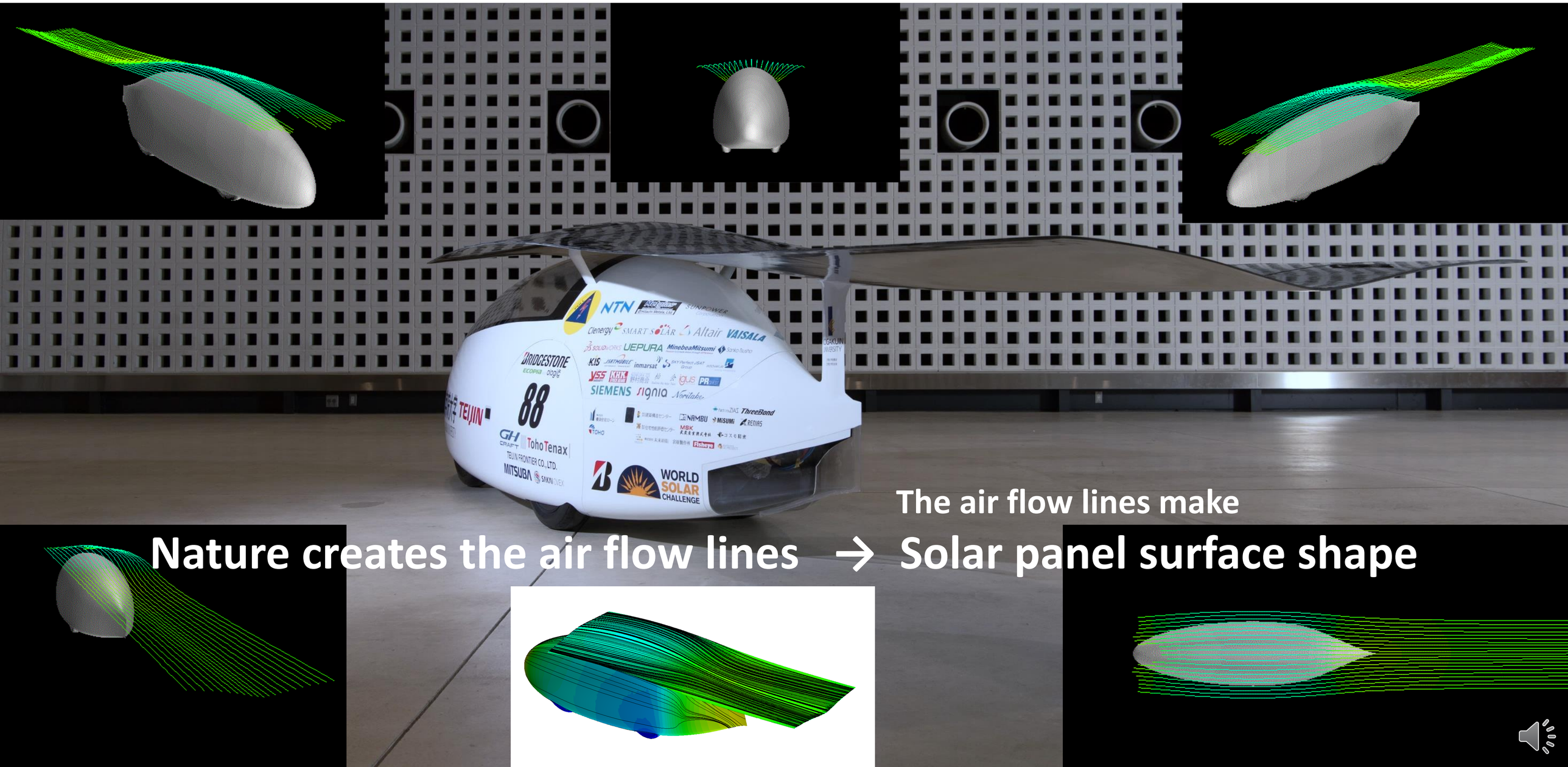
The forth car (2017)　:　Biomimetics, Nature morphing

Innovation and Philosophy

Car name:　WING

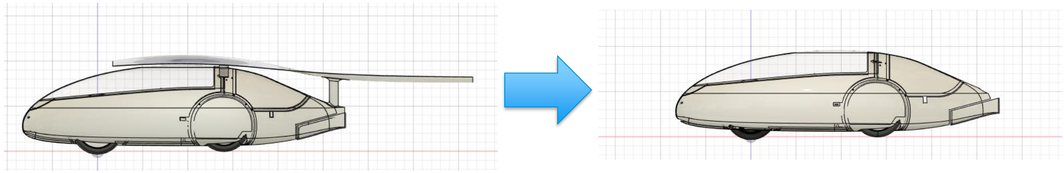
The forth car (2017)　:　Biomimetics, Nature morphing



Nature creates the air flow lines → The air flow lines make Solar panel surface shape

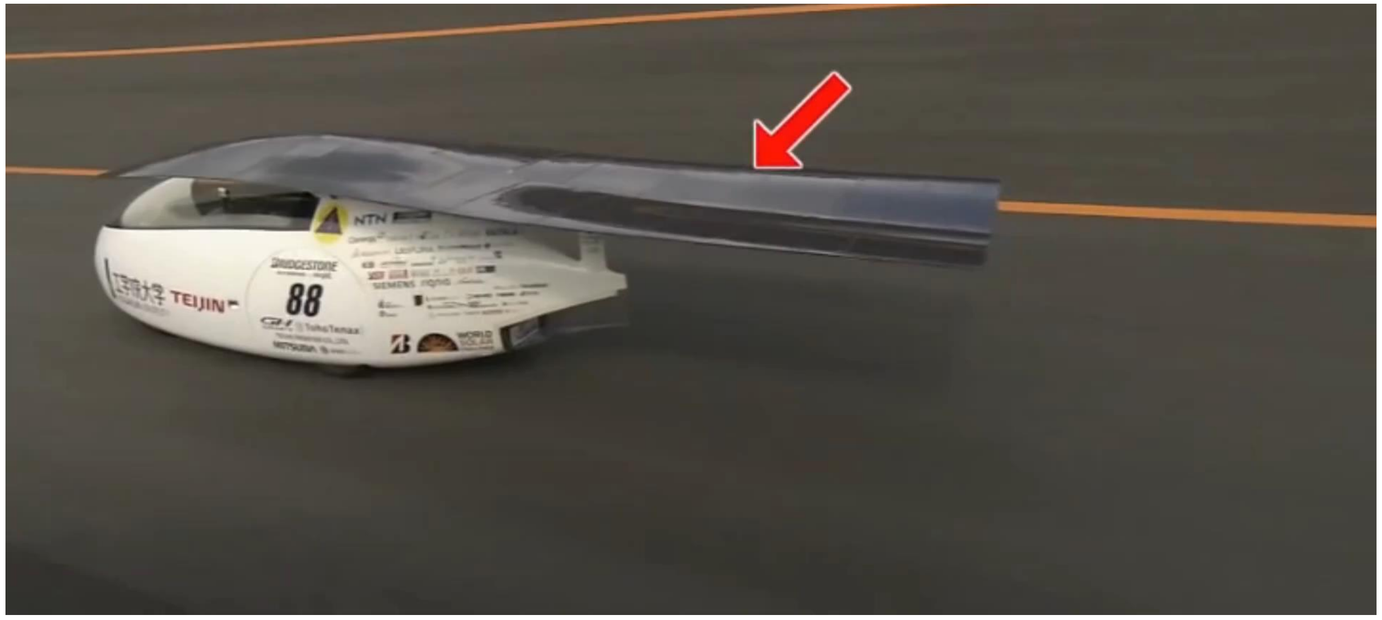
The wing may disappear !?

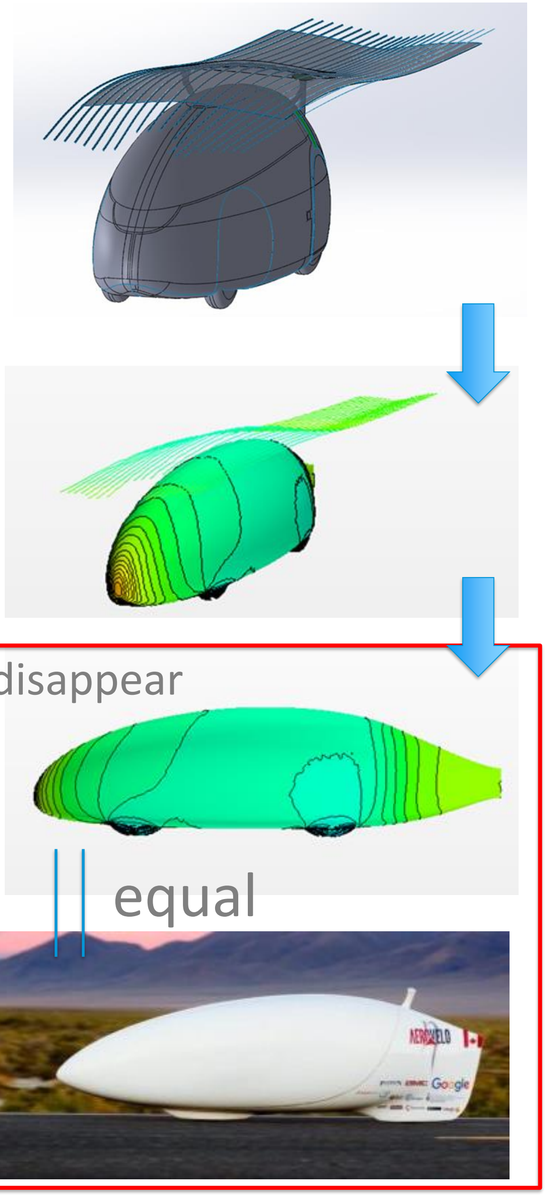
The idea :



The wing disappear at the target speed !!!???

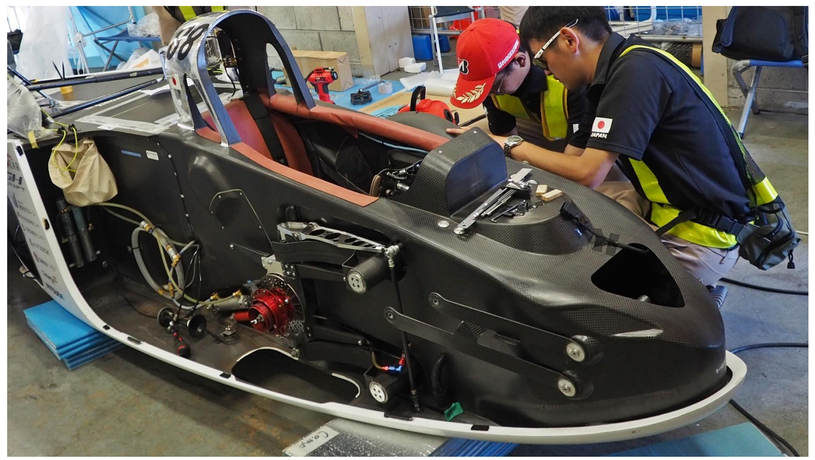
※ Due to the viscous resistance, the air resistance of the wing will not be zero.



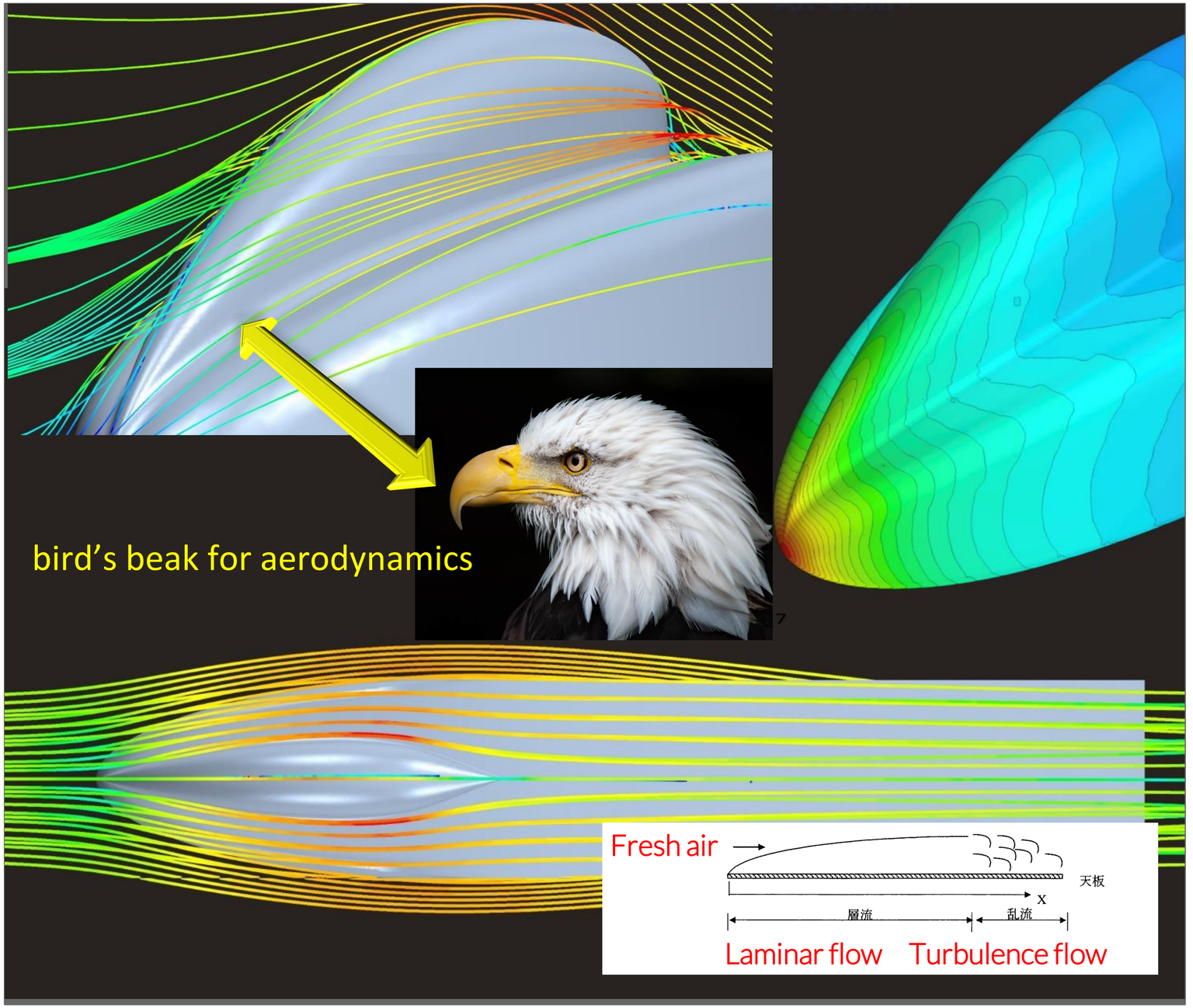


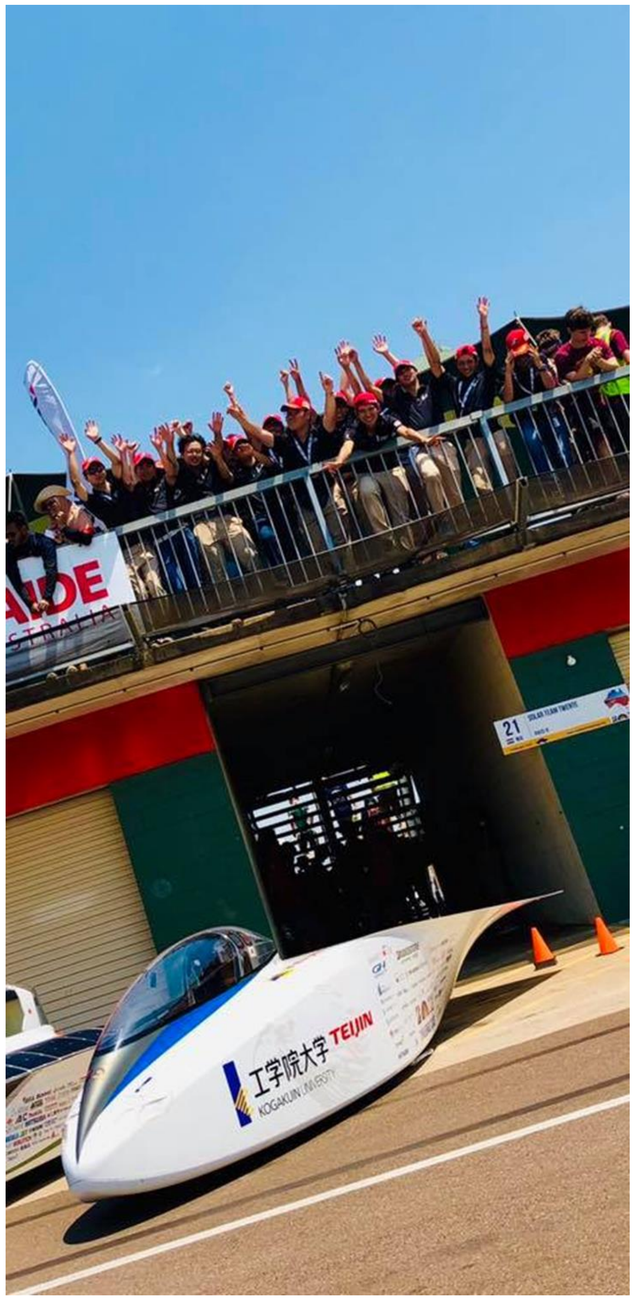
World Human Powered Speed Challenge

The fifth car (2019)　：　Biomimetics, Nature morphing



The fifth car (2019) : Biomimetics, Nature morphing





CSIRO Technical Innovation Award

CSIRO is the Australian Federal Institute of Science and Technology

(Research and development agency under the Australian Ministry of Education, Science and Training)

The award is given to the most technical invention from the participating vehicles.

Pneumatic Controlled Hybrid Suspension

Organization and management with Fusion 360

Student

300 students

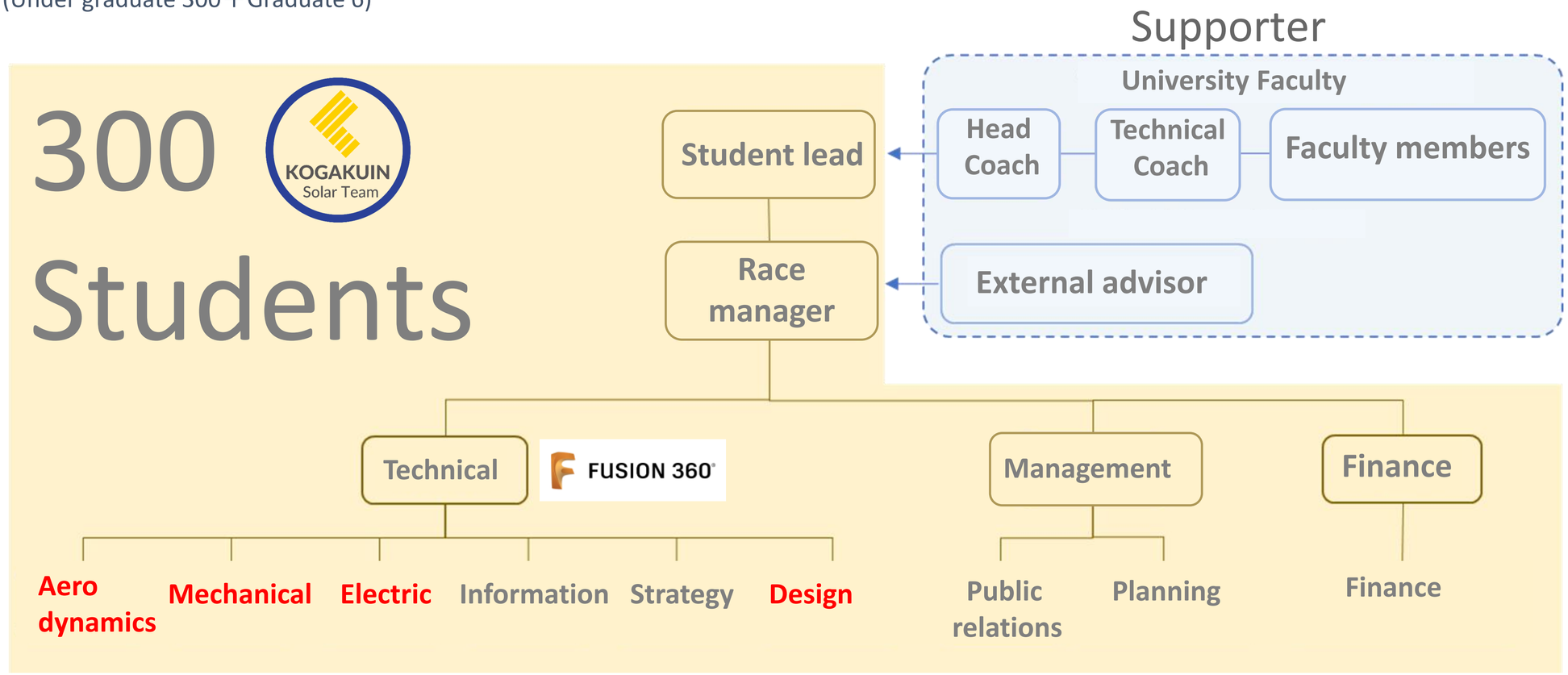
(Under graduate 300＋Graduate 6)

All departments

4 faculties / 15 departments

Faculty support

22 faculty members



Team management with Fusion 360

Problems before using Fusion 360

1. Members are perfectionists.
   After doing a perfect job, they share interim reports and drawings.
   →Delay of design/development processes
2. Members only store data on their own personal computers.
   →Collaborating with each other

Solution

AUTODESK®
FUSION 360
+
Fusion team

own personal computer

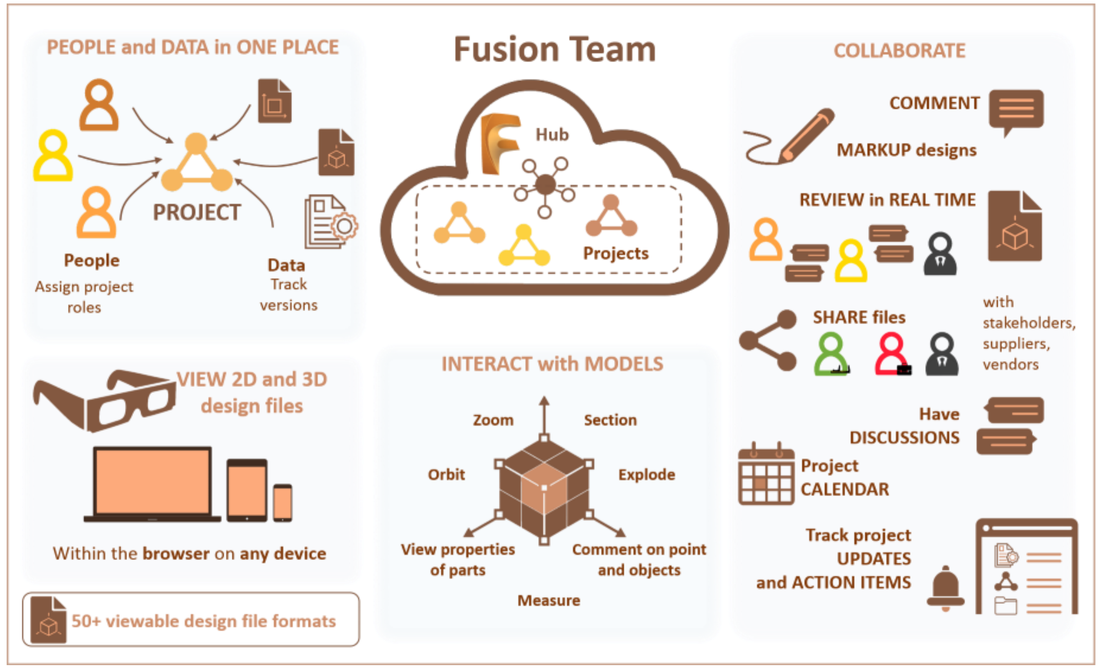
Don't take it all on yourself.

Solution

Fusion team

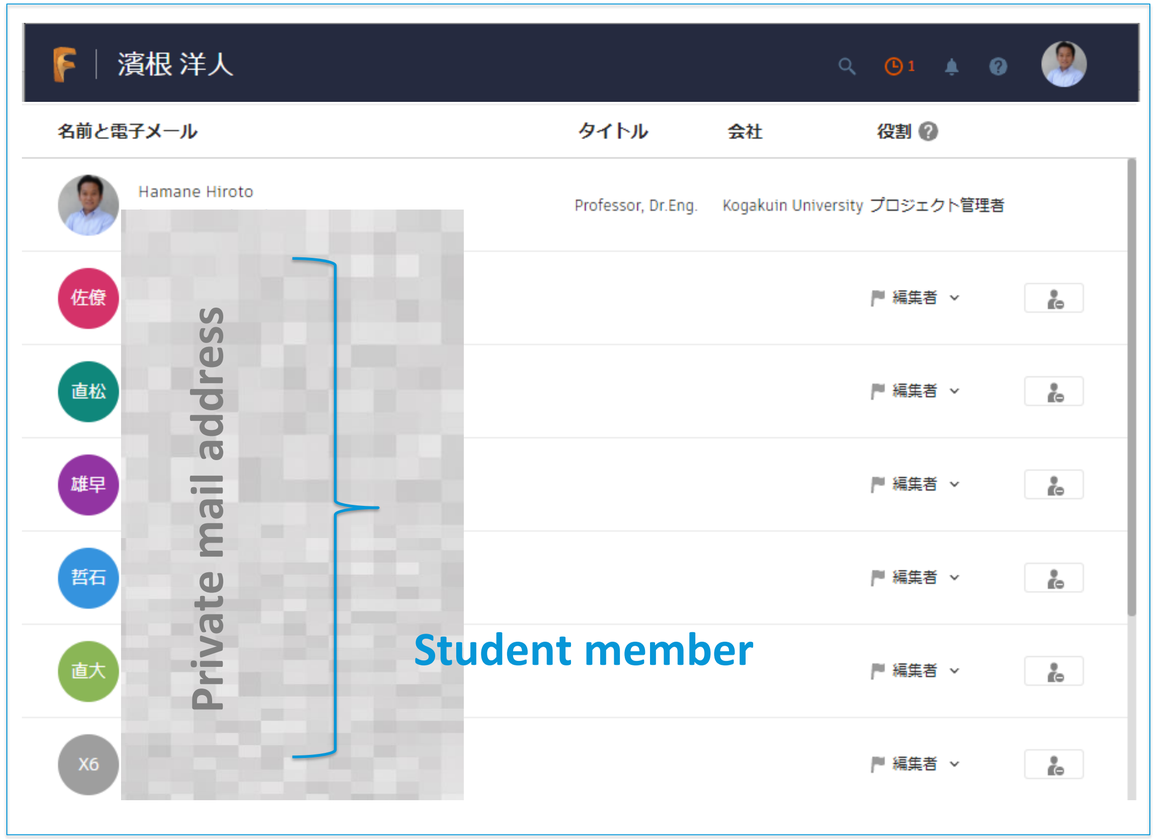
What is “Fusion Team”?

https://knowledge.autodesk.com/search-result/caas/CloudHelp/cloudhelp/ENU/FSNT-LearningCenter/files/GUID-8C18EED5-0C11-4AD7-89C5-85A81EF8906C-htm.html



- Create projects
- Add people to your projects
- Share and manage your project data
- View 2D and 3D designs within the browser on any device
- Markup designs within the browser
- Review and comment on designs individually or as a group
- Have discussions
- Manage a project calendar
- Track project updates and items that require your attention and action

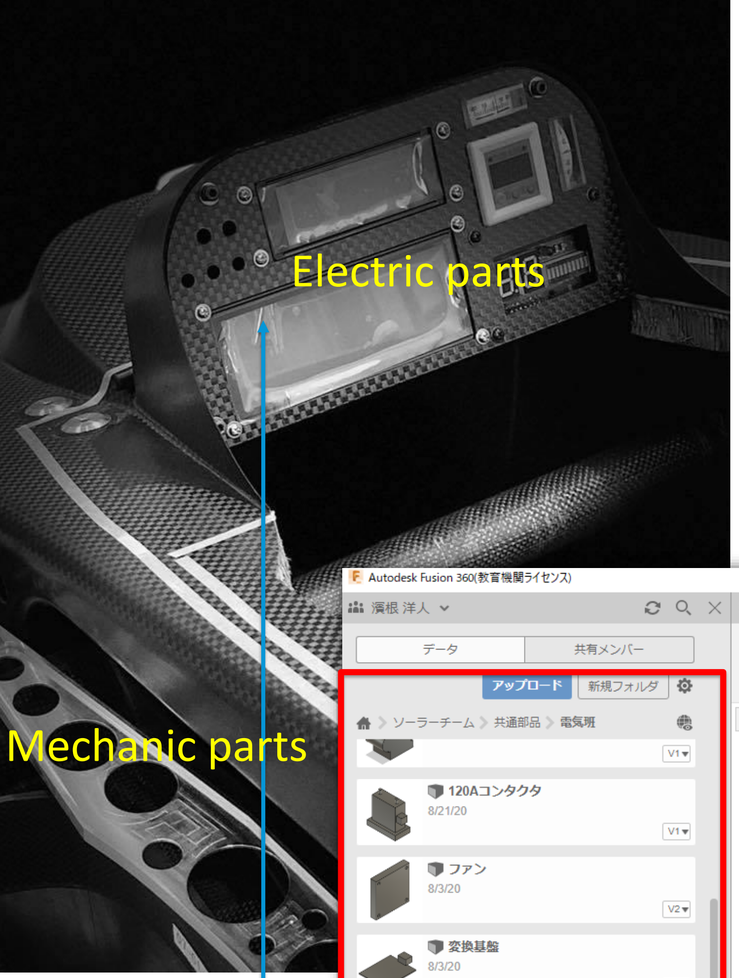
Team account: **Add people to your projects**

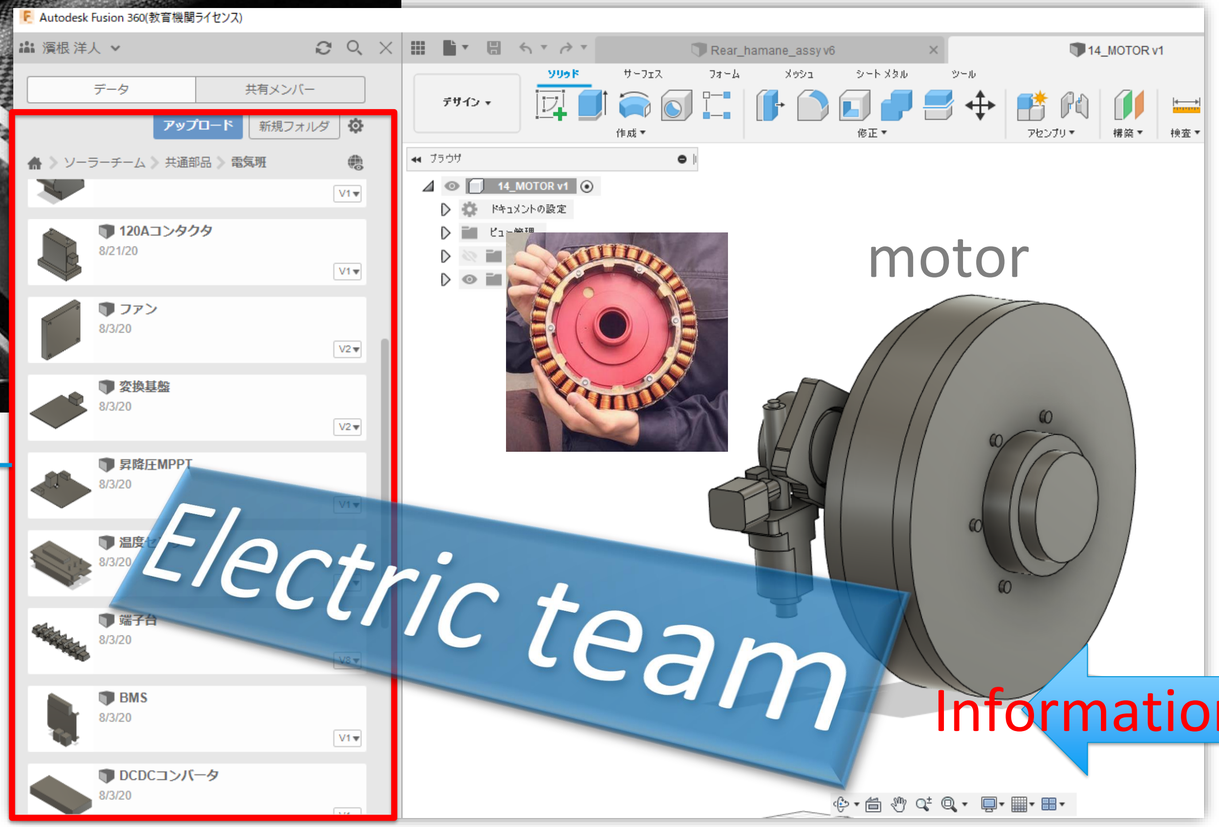


Solar Team’s Common Parts

For your information (FYI)

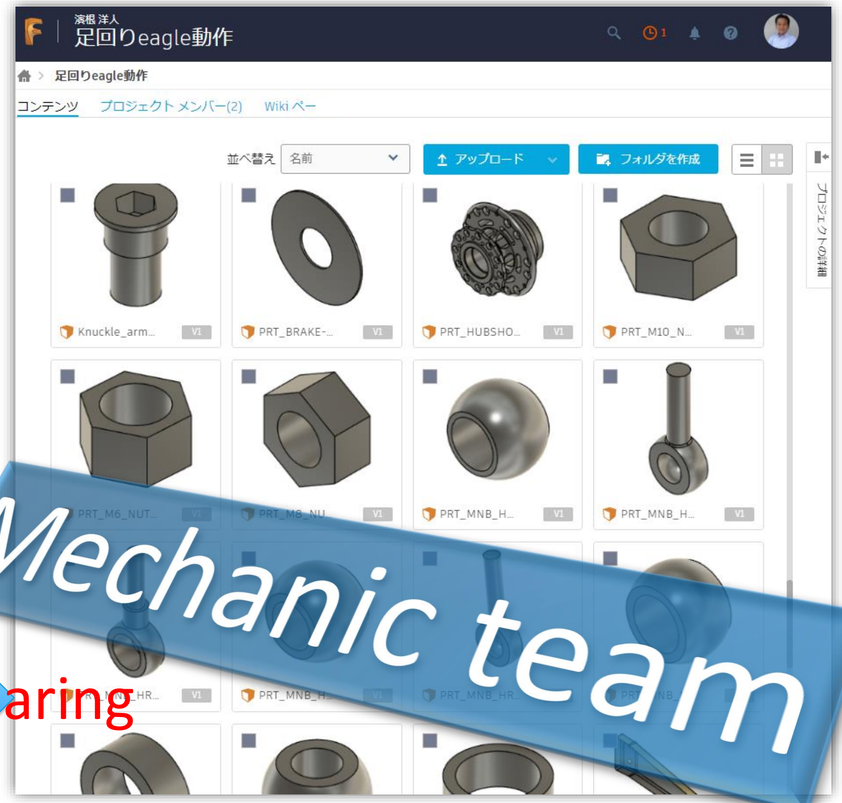
Information can be shared ***between different departments***.
Sharing has become more widespread.





Solar Team Directory

View designs within the browser on any device

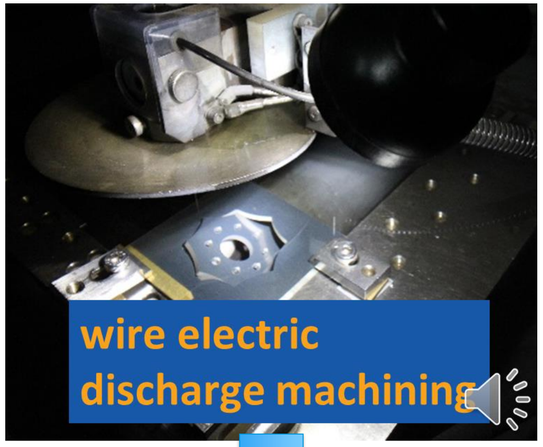


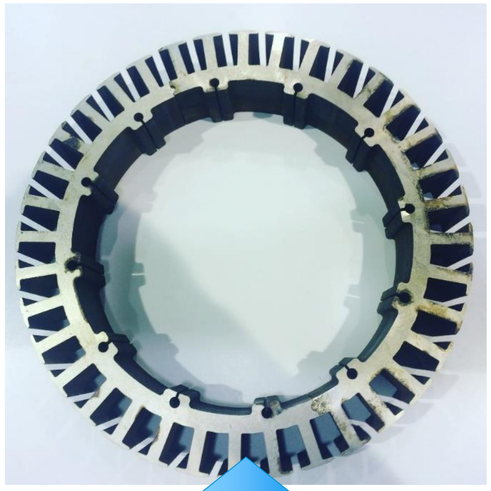
Electric team

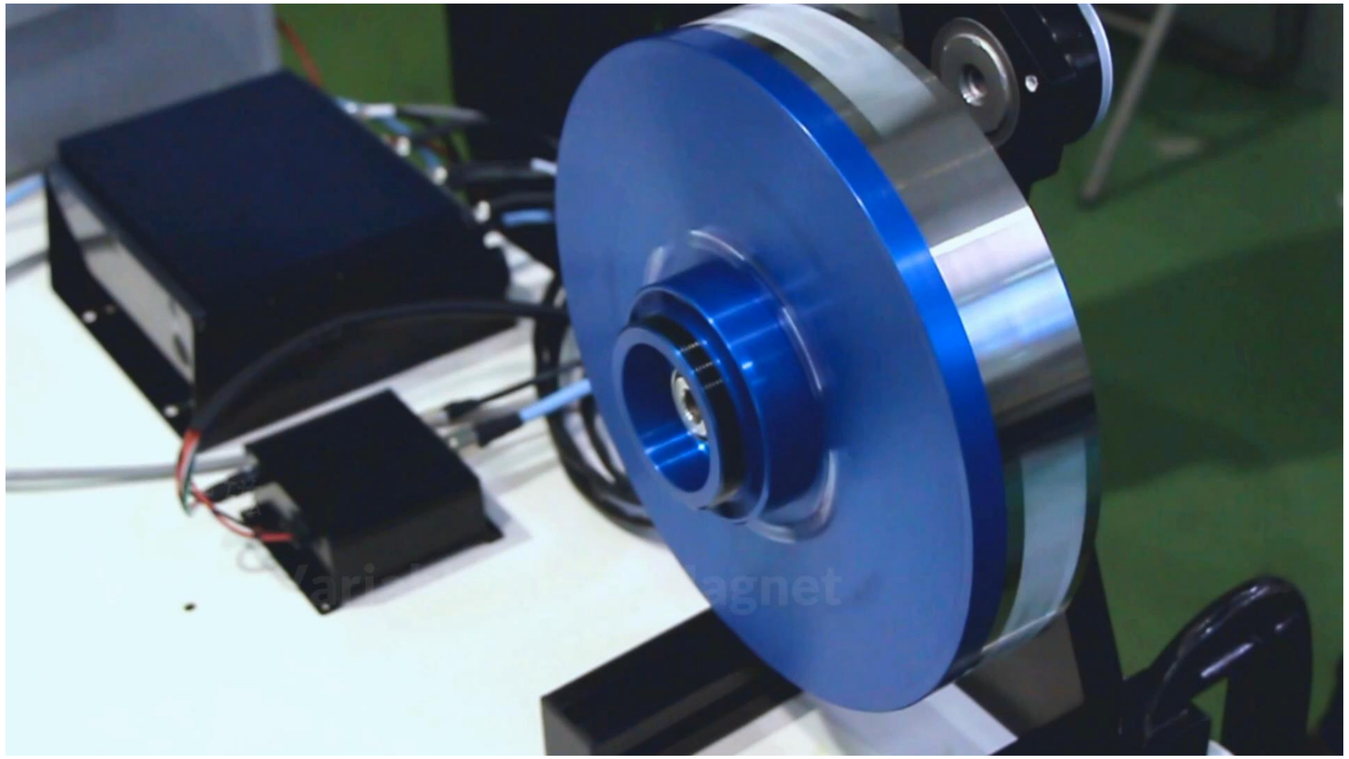
Information sharing

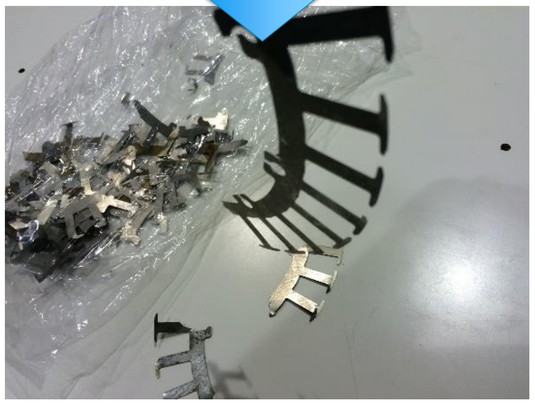
Mechanic team

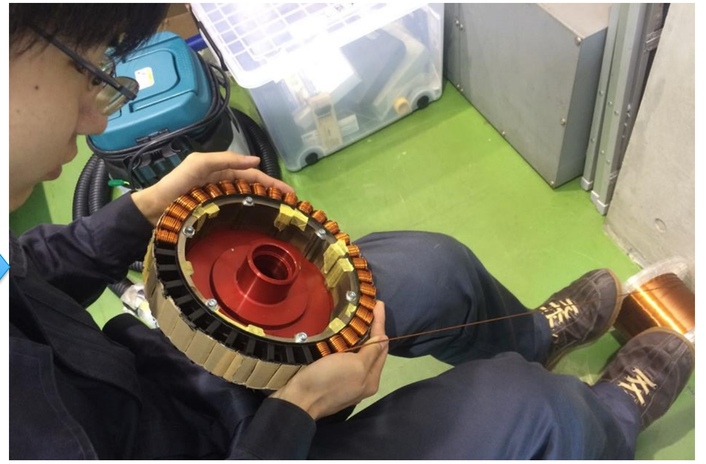
Make a motor (Electric team is also Mechanic)

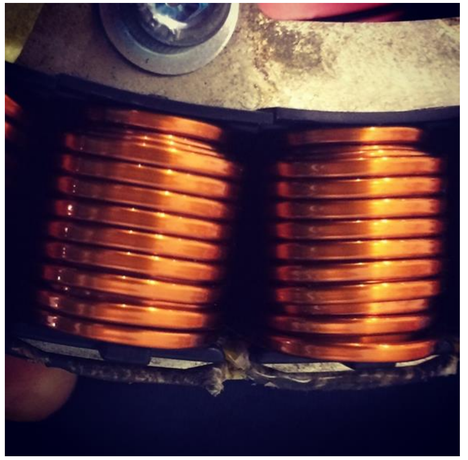




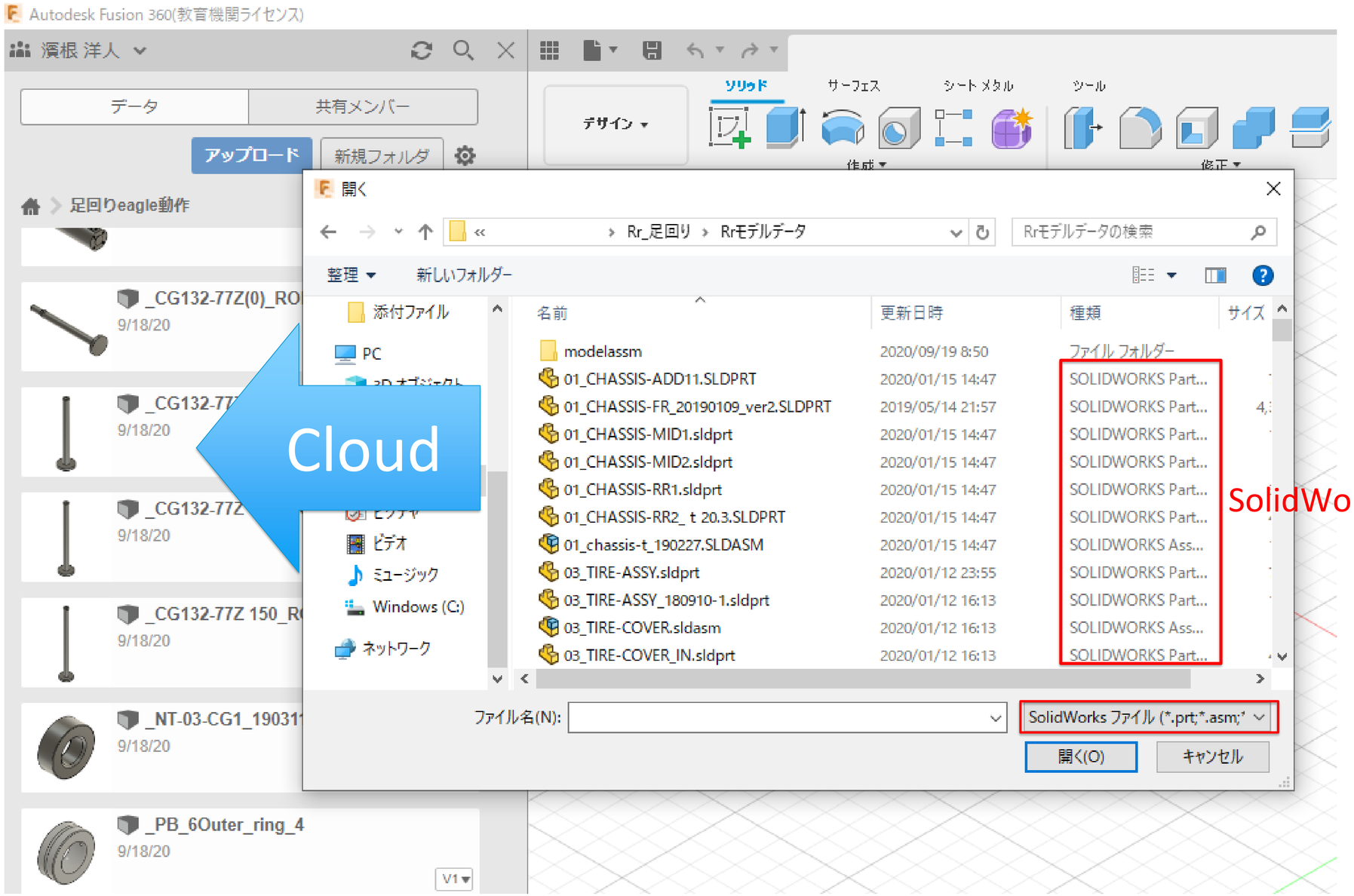






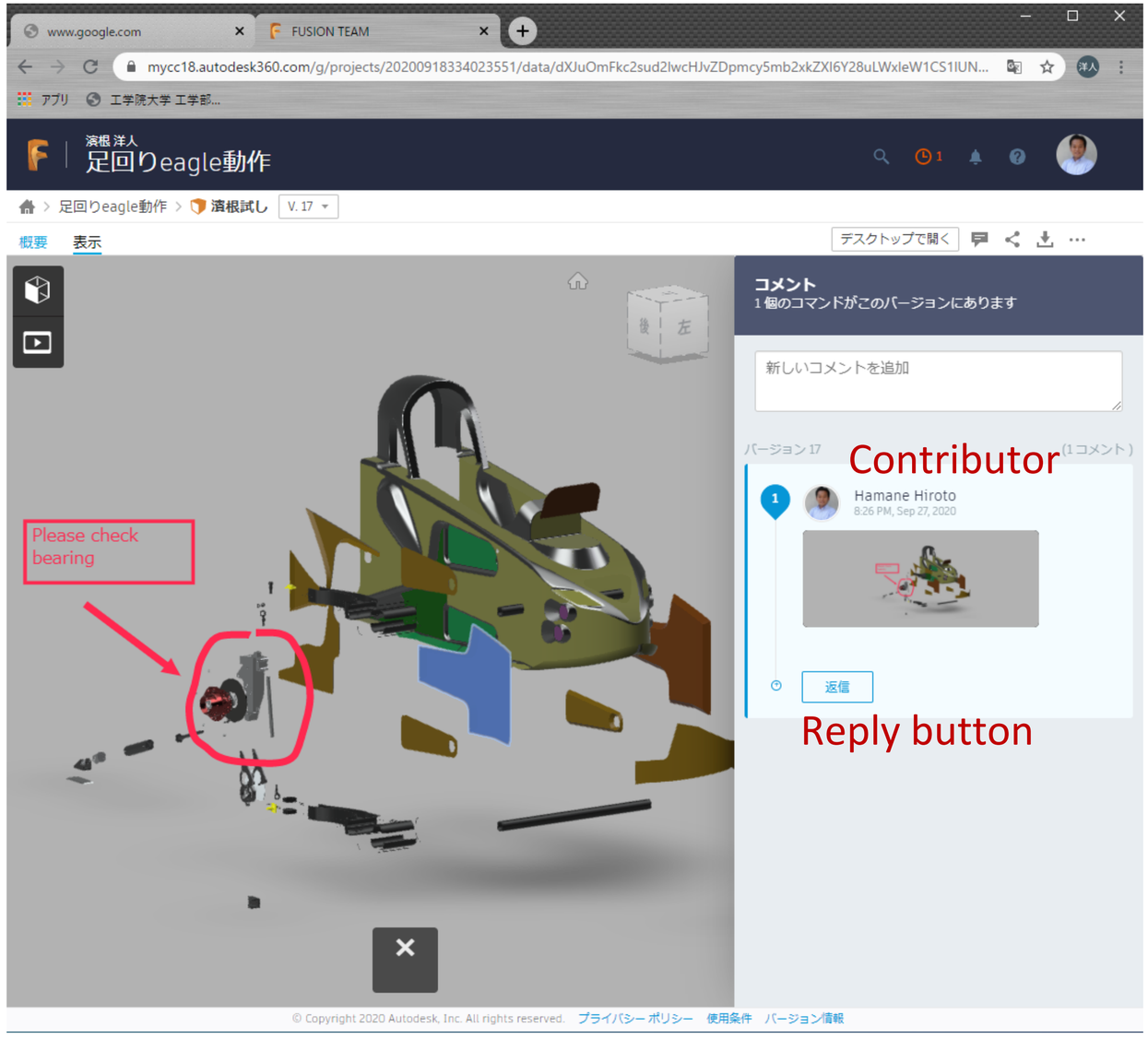


Past design data can also be used via the cloud

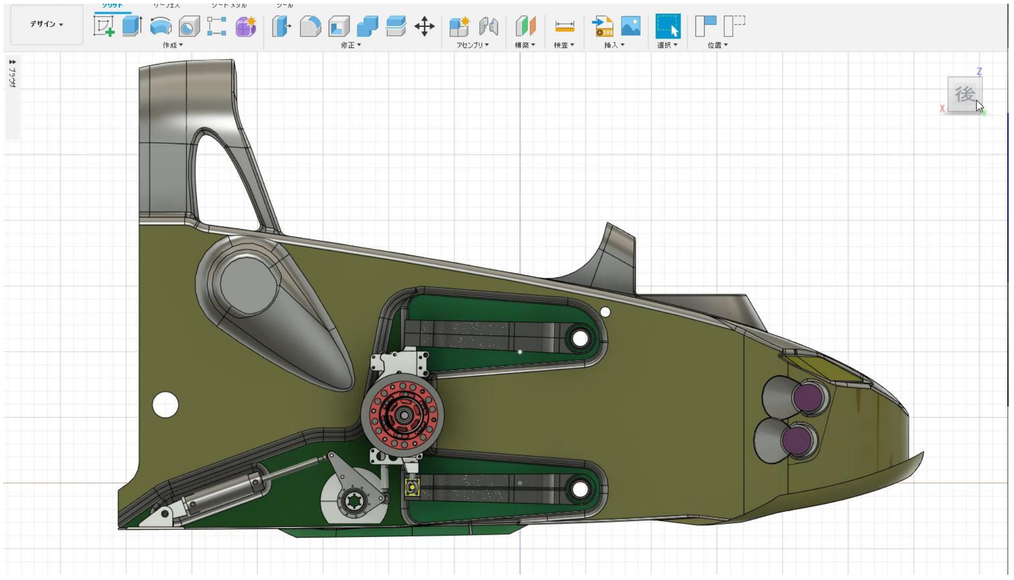


Review and comment on designs individually or as a group

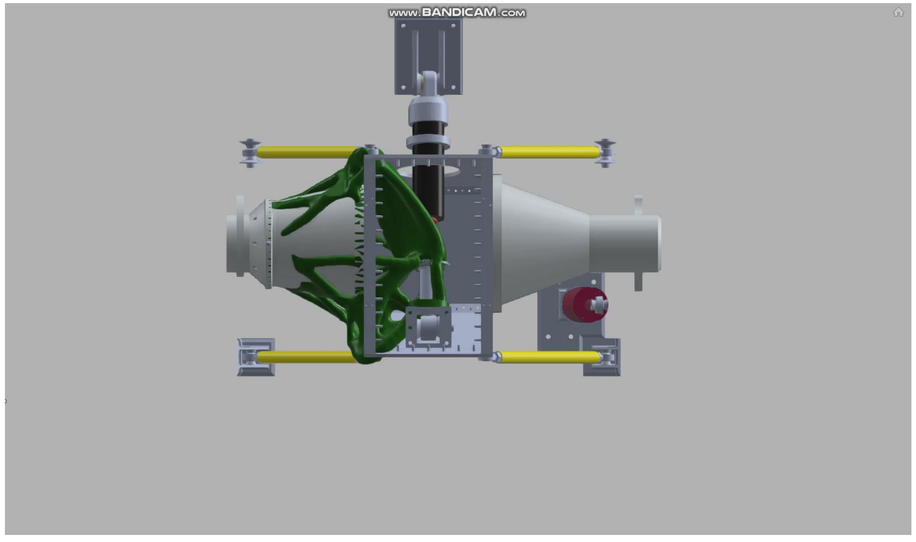
Review and comment to member via Web browser



Check geometry and dynamic behavior

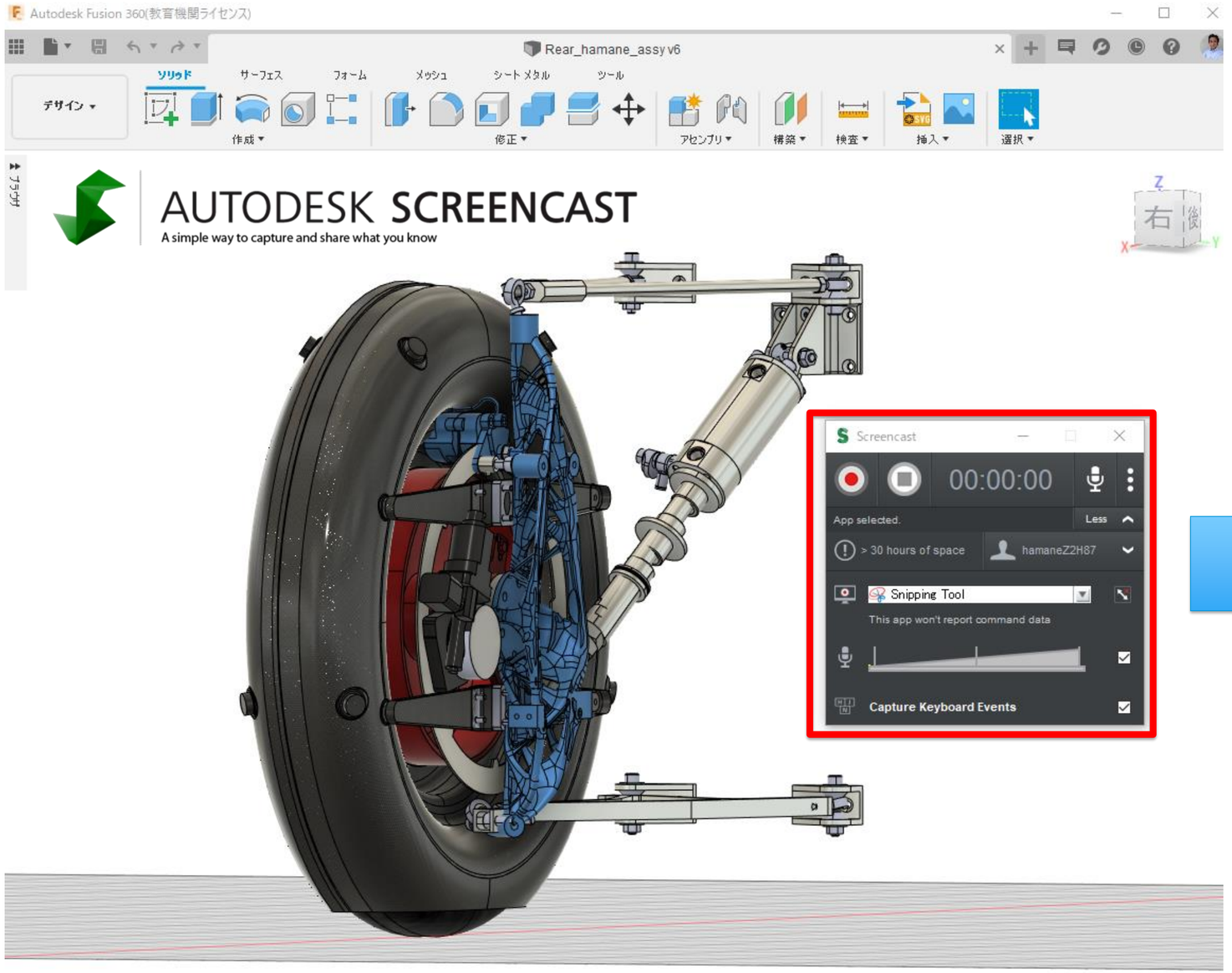


Check “Generative design” assembly



Discussion and teaching on Autodesk Knowledge Website

Screencast can easily create videos. PC and mouse operation are memorized



Teaching video on my website

PC and mouse operation are memorized

Total management with Fusion 360 (parameterization)

Primary Item

- Vehicle dynamics Suspension
- Additional functions
- Aero Parts

Secondary Item

Pneumatic Controlled Hybrid Suspension

- The mass will be heavy.(13kg)
- Non-pitch non-roll
- Vehicle height adjustment

Reduced consumption（30W）

Double wishbone suspension

- The weight will be lighter(7kg)
- Simple structure

Trade off

ADOPT

4WS Yacht running

- The mass will be heavy.(5kg)

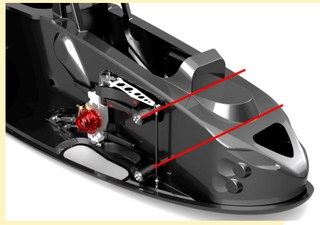
Reduced consumption（70W）

Weight reduction by standardizing parts.

Change to CFRP parts.

（Solved the weight increase for the new suspension）

ADOPT

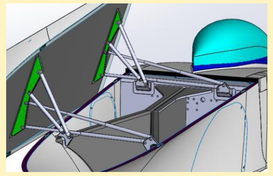


ADOPT

Comprehensive judgment

Door : one side opening and closing function

- Simple structure
- Lighter



Door : Both sides opening and closing function

- Reduced operation time

2 minutes reduction at control points

ADOPT

Aero-fin

- Improvement of air resistance

Tire cover

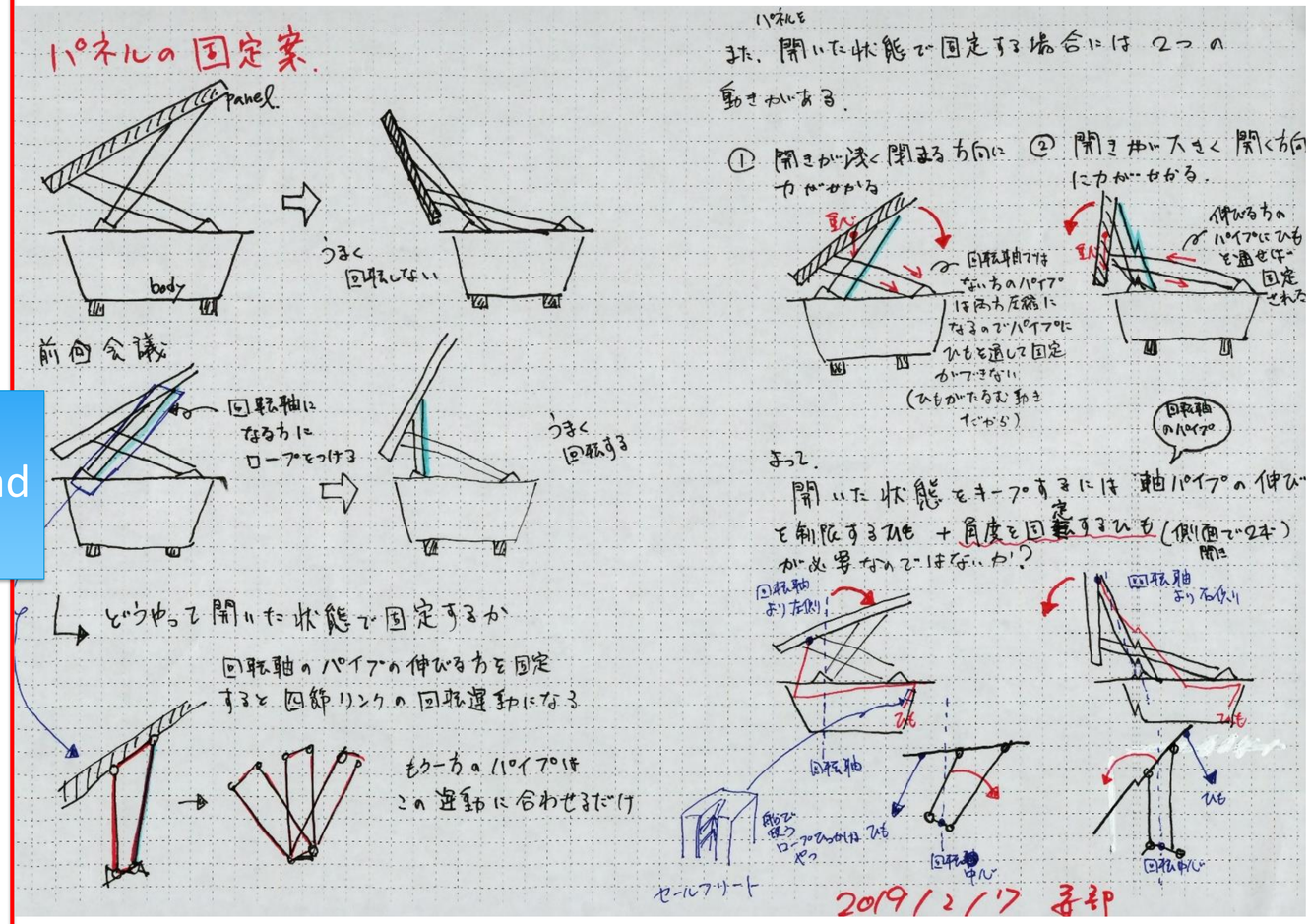
ADOPT

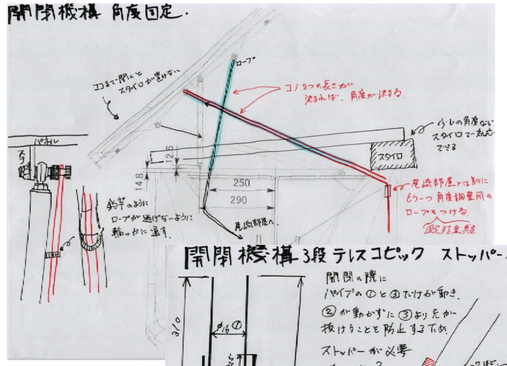
Goal

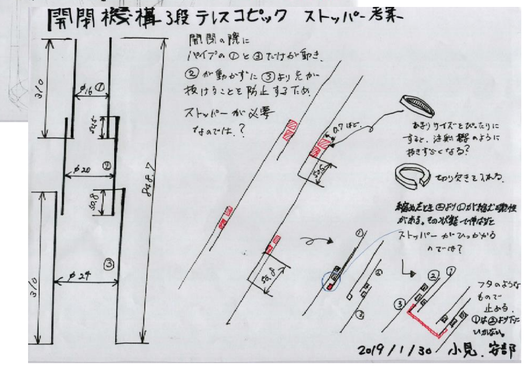
Total consumption reduction approximately 12.5%

Handwriting for new ideas on Fusion 360

PDF, Photo, Microsoft office data can be uploaded to cloud.





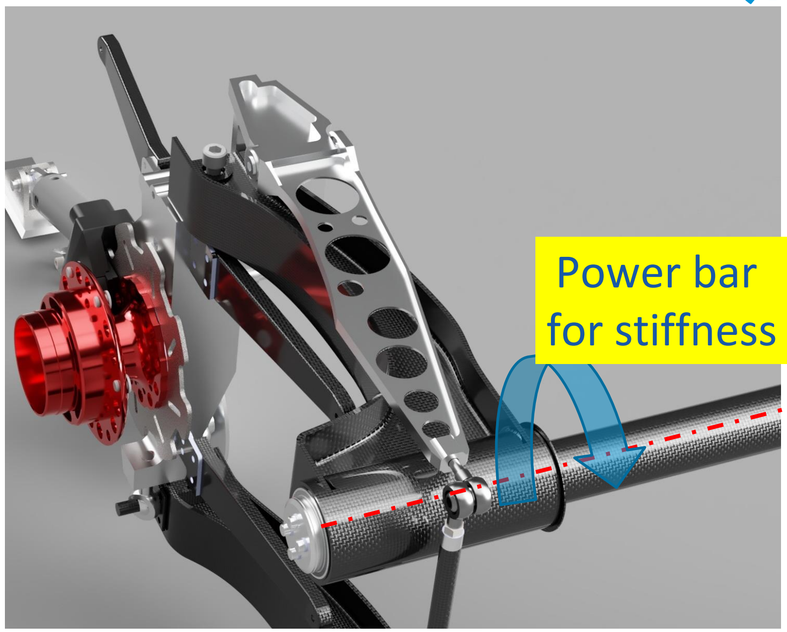


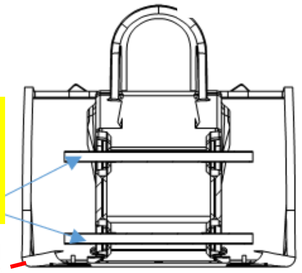
For your information (FYI)

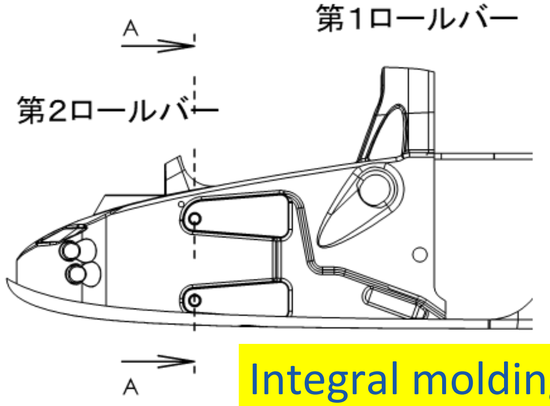
「sentence」→「Manga (draw illustrations)」

Weight reduction by common parts. Change to CFRP parts.

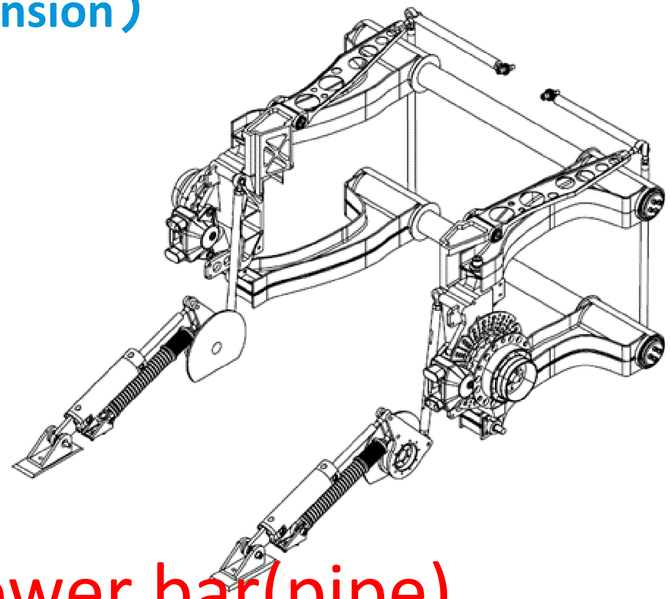
（Solved the weight increase for the new suspension）



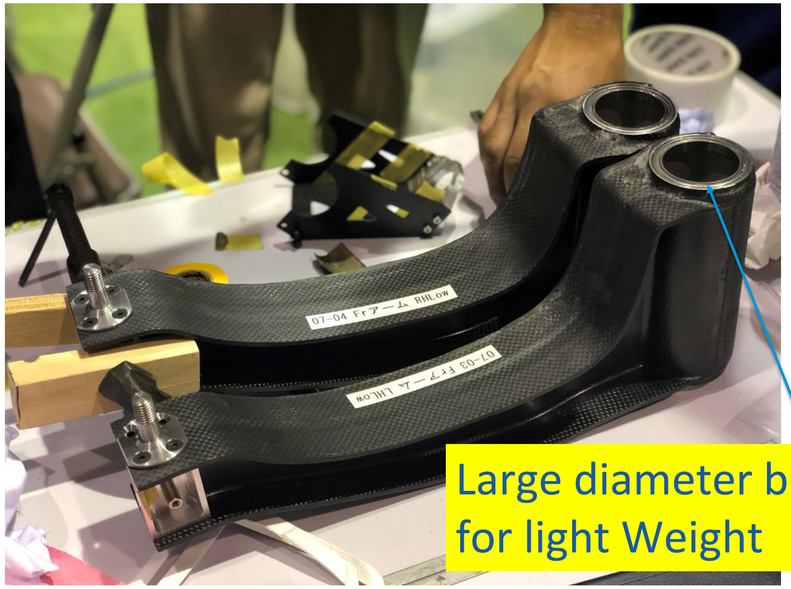




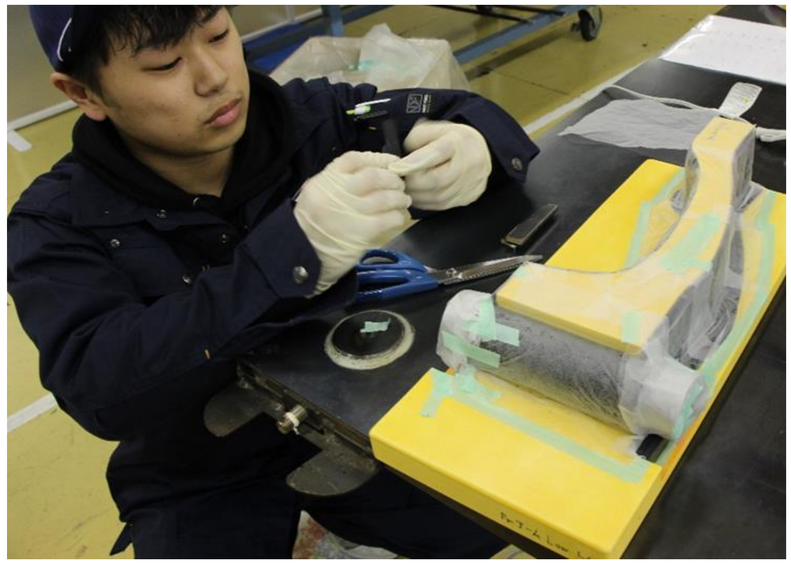
Integral molding



Common swing arm and power bar(pipe)



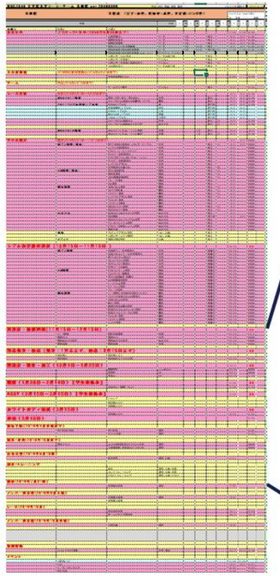
Large diameter bearing
for light Weight



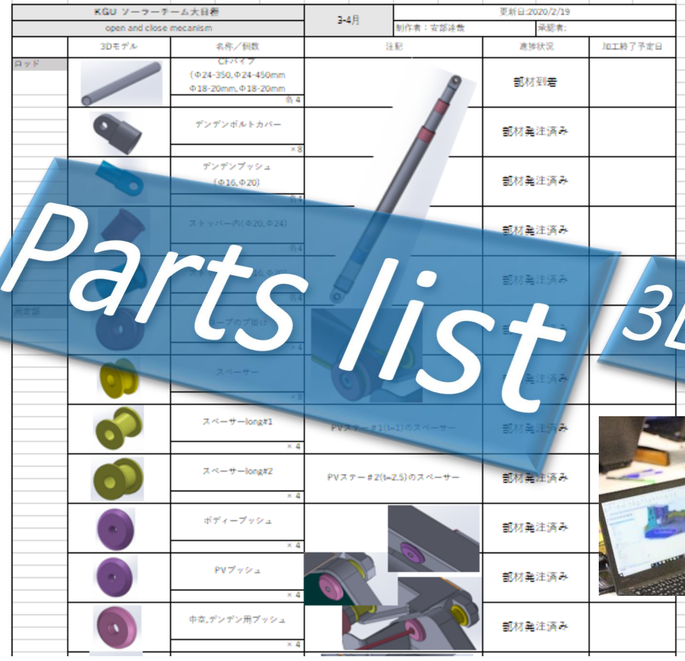
Schedules

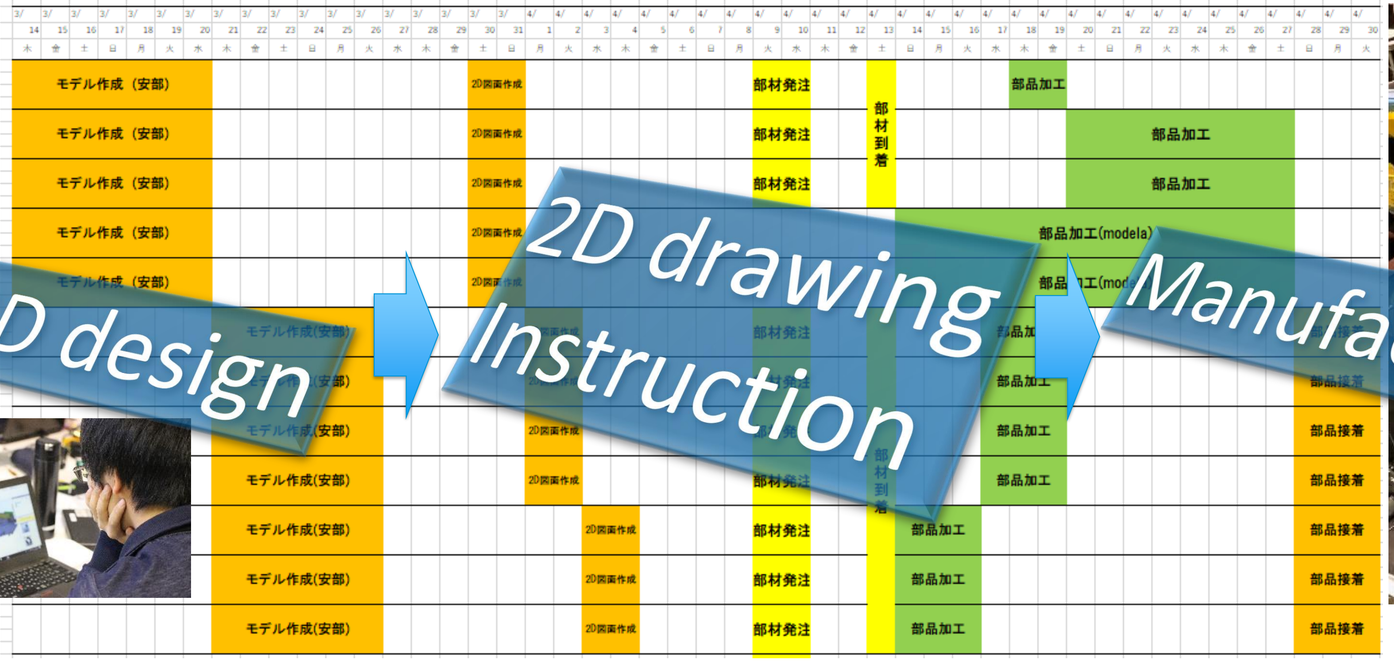
Master schedule (2 years)

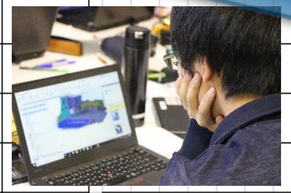
2 years

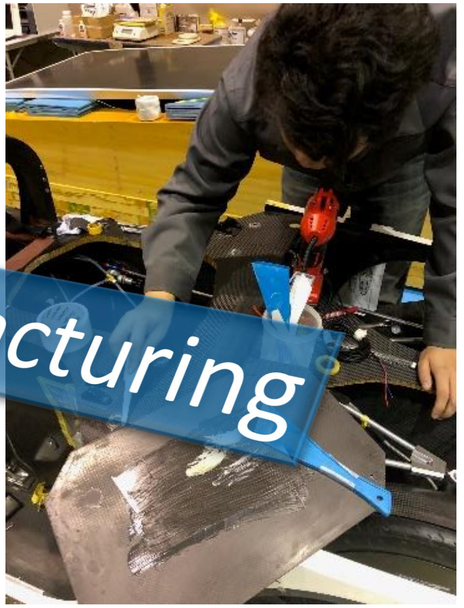


Intermediate schedule









Parts list

3D design

2D drawing
Instruction

Manufacturing

Detailed schedule

5W1H

Who, Where, What, When, Why, How

＜Machining plan＞

加工項目表					未着手			途中		完了
				作成者	瀬戸	作成日	20190527			
No	項目	個数	状況	図面	メイン担当者	開始予定日	開始日	完了予定日	完了日	備考・状況
7	PVブラケットスペーサ＃２		完了		清水			2019/5/11		２つ
8	デンデンカバー		完了		尾崎	2019/5/9		2019/5/16		元部材1つ完
9	デンデンブッシュΦ16		完了		越坂			2019/5/14		あとは角取り1つのみ
10	デンデンブッシュΦ20		完了		瀬戸	2020/2/18		2019/5/15		1つの穴だけ
ブレーキ										
1	ハンドブレーキ		完了		CNC					
2	ペダルパッド2		完了		上原	2019/5/17		2019/5/11		タップの長さが足りない
3	m6ブッシュ(メネジあり)1		完了		全員			2019/5/13		5/15NC
4	m6ブッシュ(メネジあり)2		完了		全員			2019/5/20		5/20NC
5	m6ブッシュ(メネジなし)1		完了		全員	2020/2/18		2019/5/13		5/13NC
8	Φ6ロッドエンドスペーサー1		完了		瀬戸	2019/5/14		2019/5/20		5/20NC
9	Φ6ロッドエンドスペーサー2		完了		田中			2019/5/13		後1つ
10	Φ6スペーサー1		完了		高橋	2019/5/11		2019/5/14		後1つ

Parts list

Who, Where, What, When, Why, How

Progress management table for each group

Progress of each member can be checked at WEB SITE.

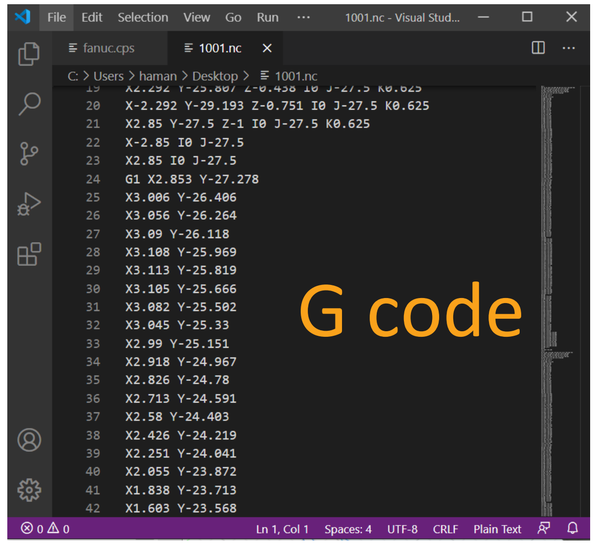
UPDATE

Team Progress Table

ステアリング・ラック＆ピニオン						ハンドル・ブラケット					
3Dモデル	名称／個数	注記	進捗状況		発注型番	3Dモデル	名称／個数	注記	進捗状況		発注型番
	ベースプレート ×1		完				側面カーボン板 ×2		加工済み		
	ラックアダプタ_L,R 各1個		完				背面カーボン板 ×1		加工済み		
	シリンダーアダプタ ×1		部品到着				正面カーボン板 ×1		加工済み		
	ピニオンボックス ×1		完				ピローブロックブラケット ×1		加工済み		A5083P-K10-65-65-10
	ピニオンフレームFr ×2		加工済み		PNFNN120-120-9		アーム軸ブラケット ×2		加工済み		
	ピニオンスペーサ ×1		加工済み				アーム軸ブラケット2 ×2		加工済み		
	ベアリング(6202ZZ) ×2		完		6202ZZ		アーム軸リング ×2		加工済み	図面修正必要	A2017-BP-42-80
	ストッパ ×2		加工済み	図面修正必要			ハンドルシャフトカップリング(ETP-E-015ーNH) ×1		部品到着		ETP-E-015-NH
	ストッパープレート ×2		加工済み		TF50-50-10		カップリングハブ ×1		加工済み		FRDOC-D26-L23
	当て板 ×2	シリンダーとシリンダーアダプタを繋ぐ金具	加工済み		A7075P-6F-BSD-NNN-100-60-8	ピローブロック					
	センタリングシリンダー ×1		部品到着		CG1WBH20-75FZ		ベアリング抑え ×1		加工済み		A2017P-4F-BSXAQ-NNL-60-60-10
							ベアリング(6804ZZ)		部品到着		6804ZZ

Each Machining Control by the Cloud of Fusion 360 CAM

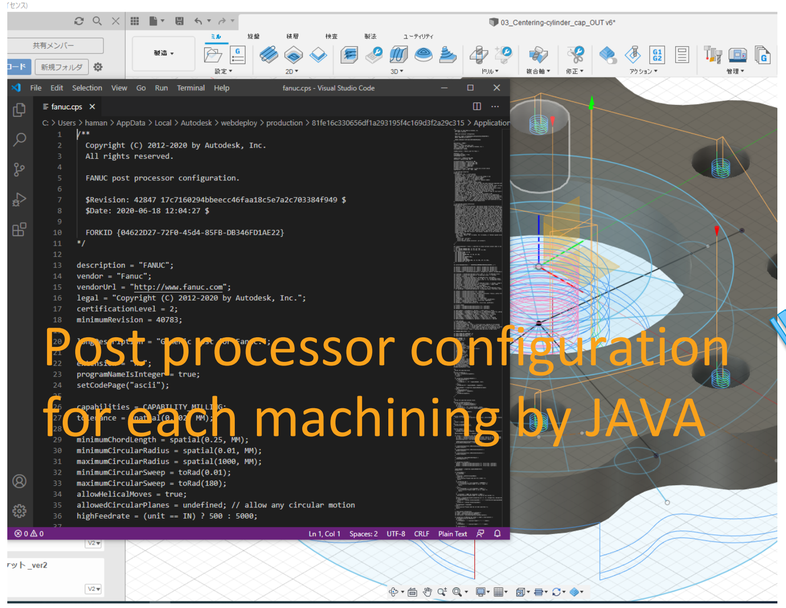
Technical Support Center



G code

CAM

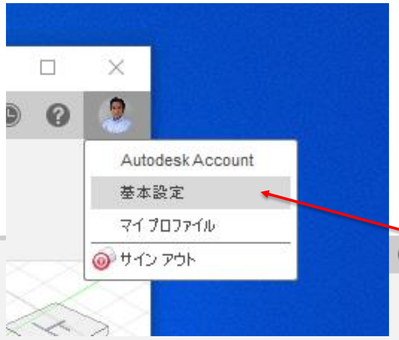
cps file

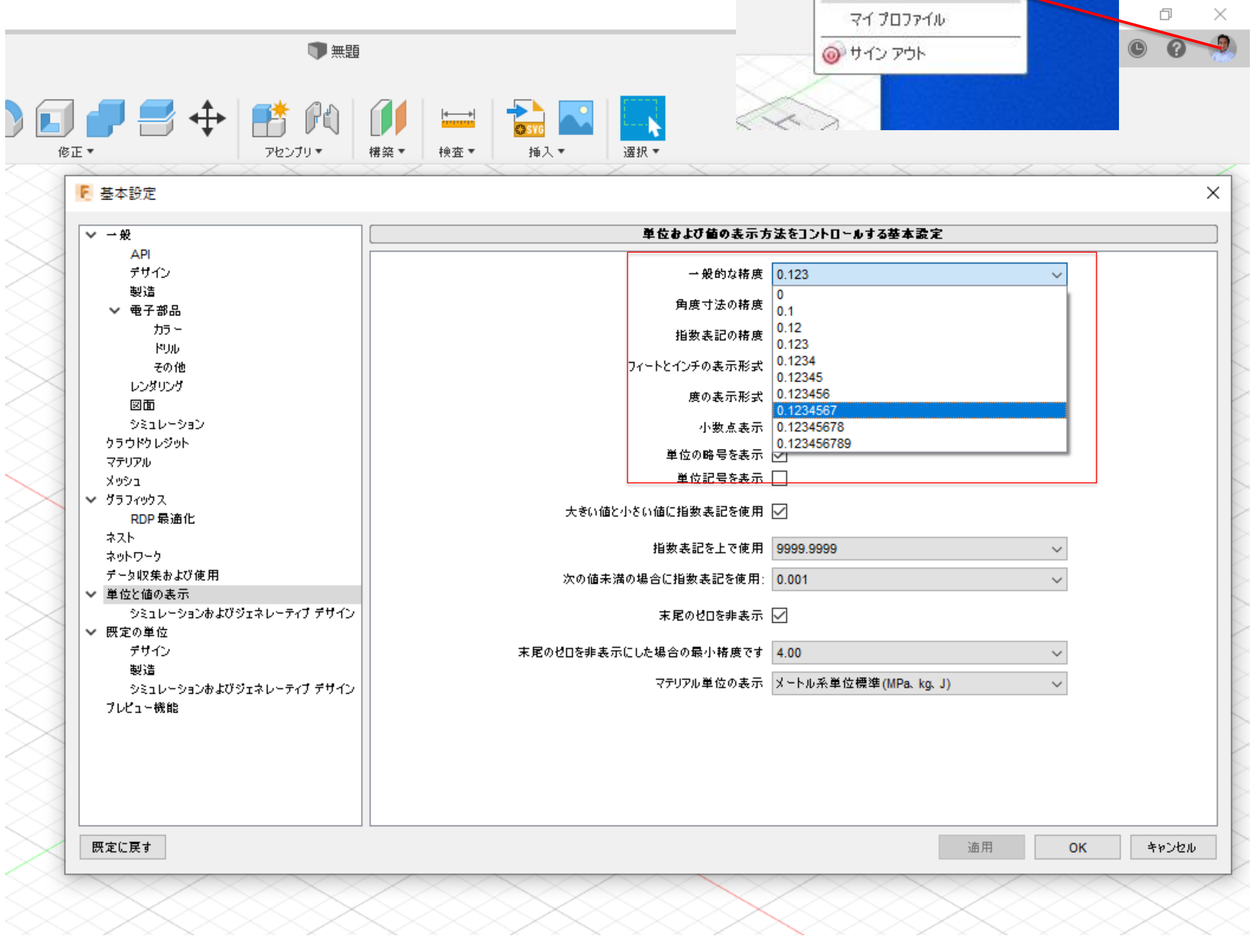


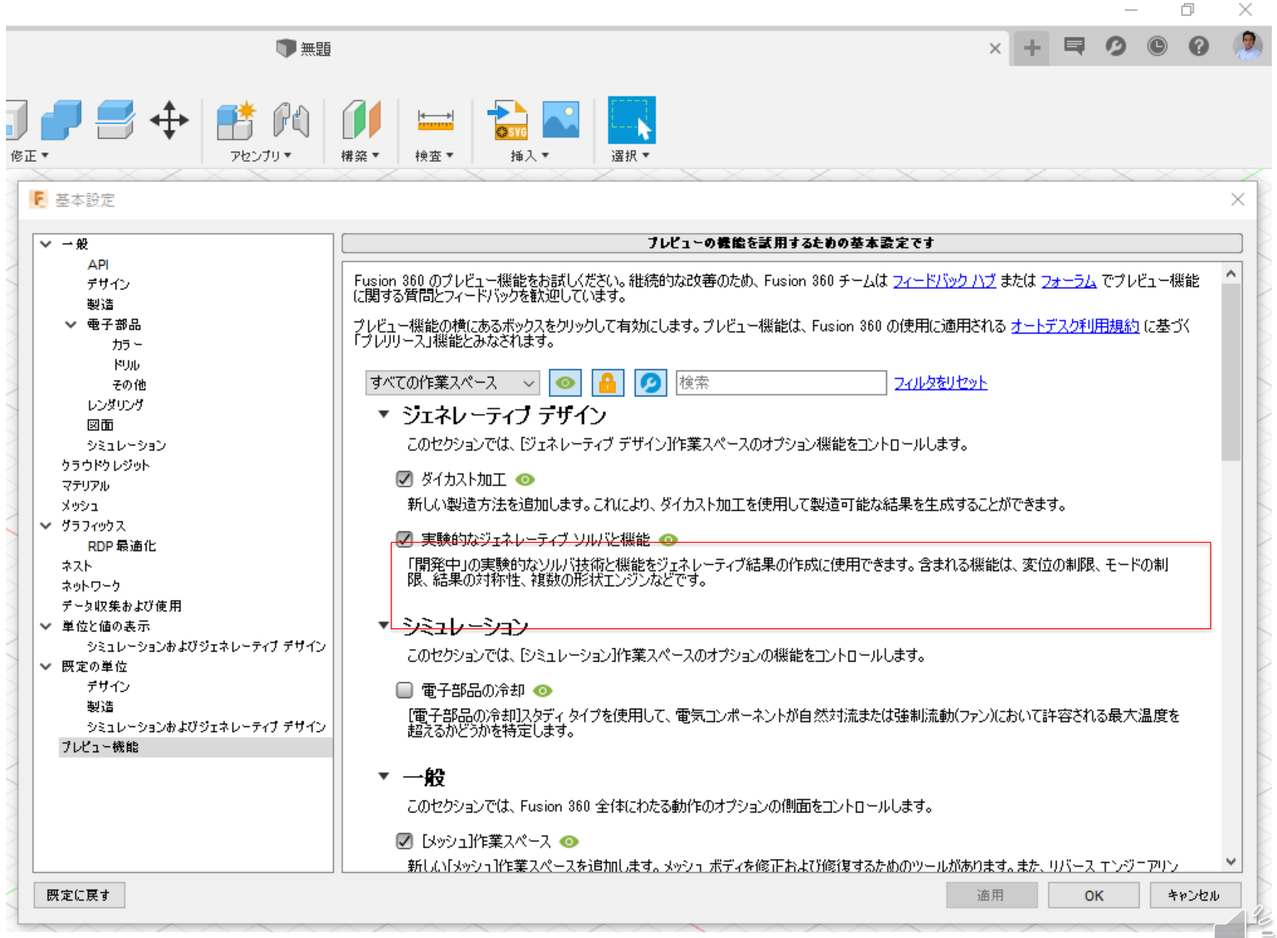
Post processor configuration
for each machining by JAVA

You can find the settings button by clicking on your photo.

Make sure everyone on the team has the same settings.

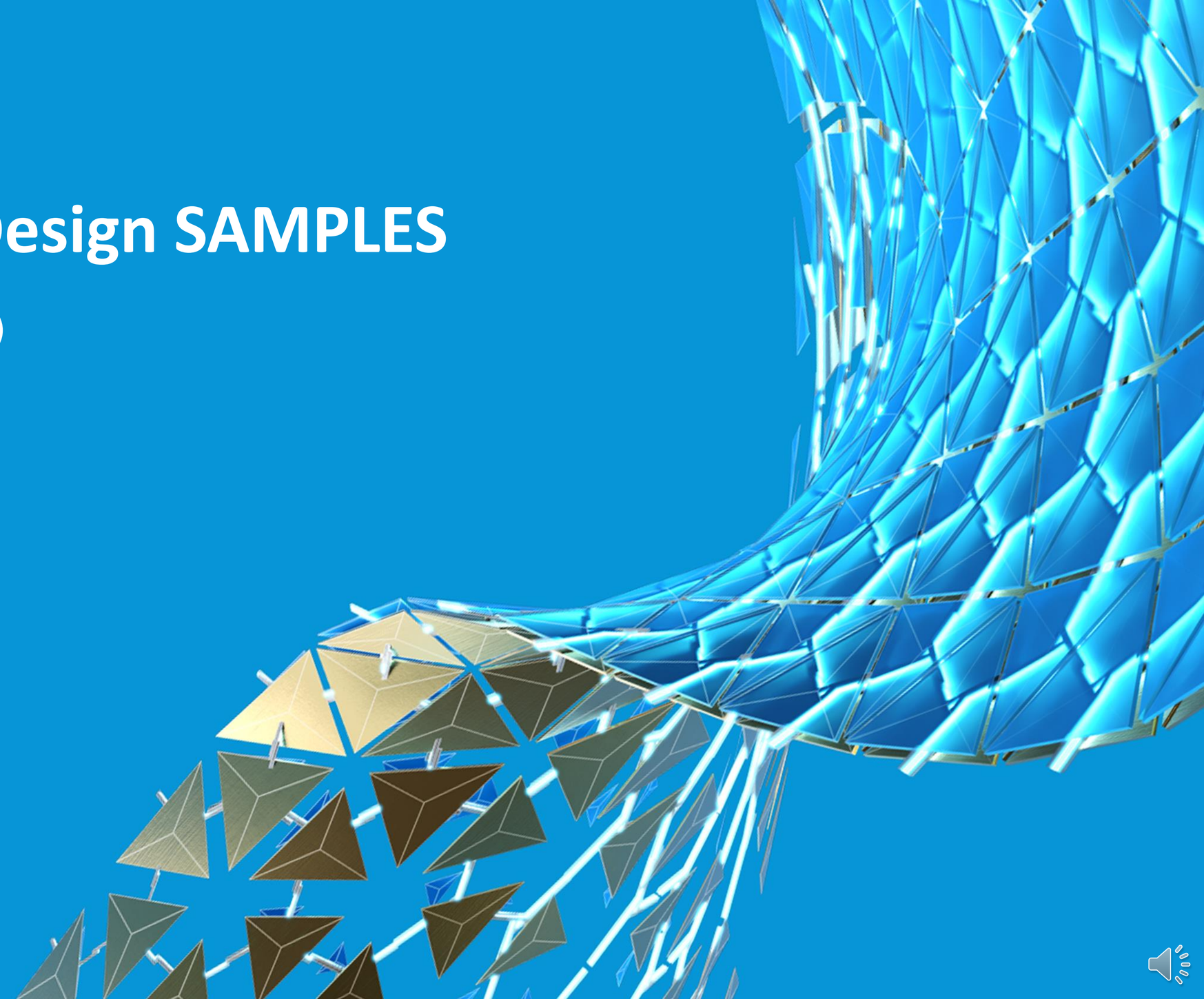






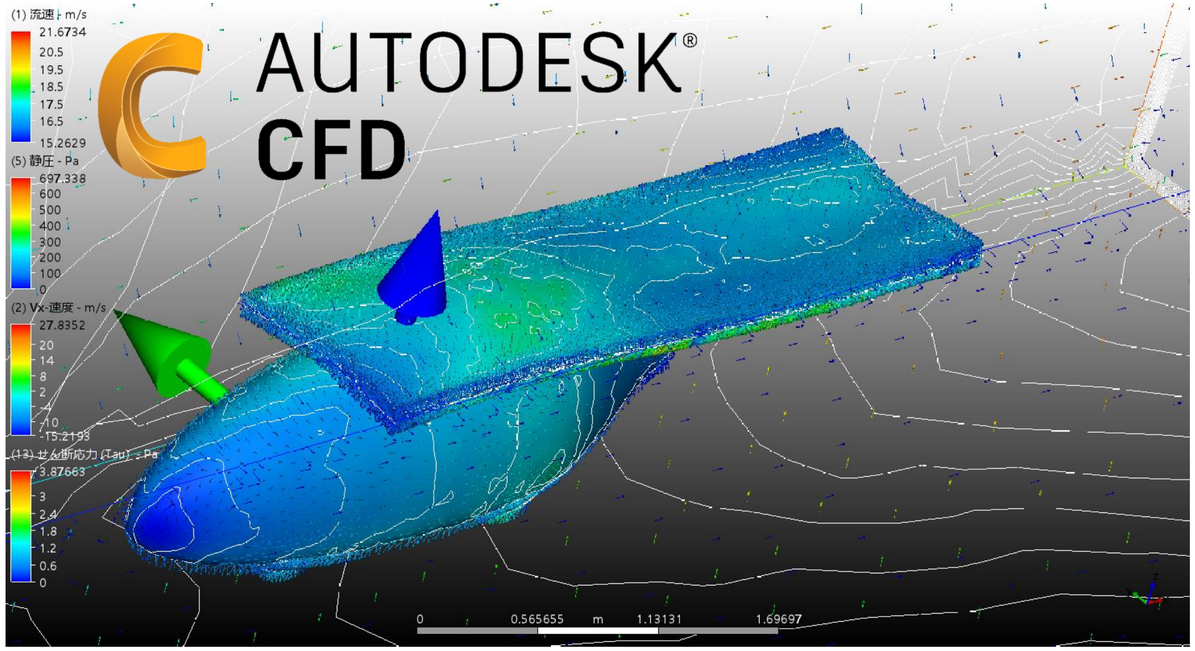
Solar Vehicle Design SAMPLES

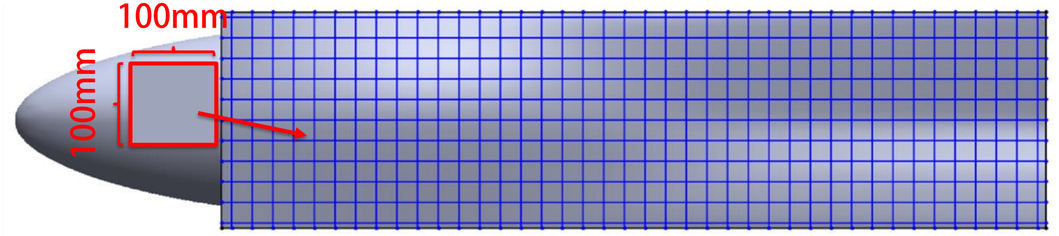
- Fusion 360 Simulations (FEM)
- Fusion 360 + Autodesk CFD
- Generative Design
- CAM

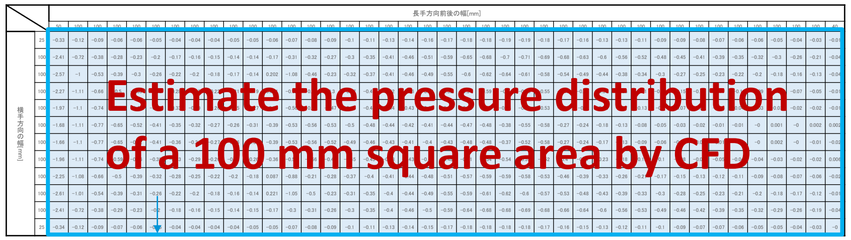


Wing will be destroyed?

How to estimate the load on the wing ?







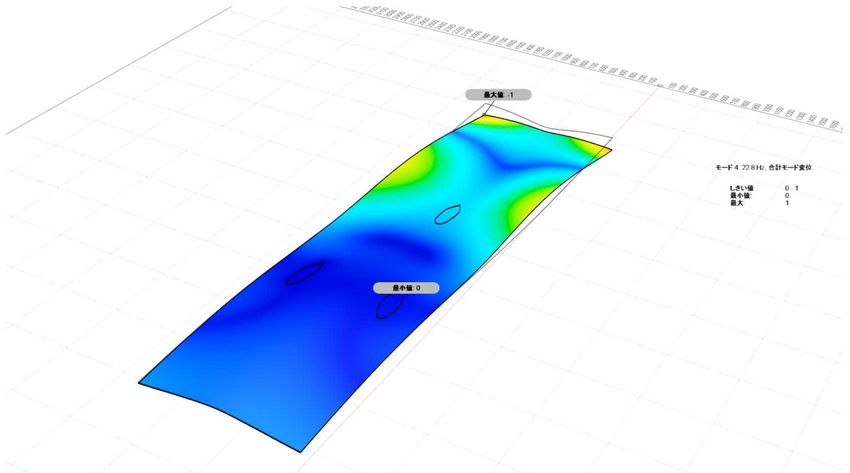
The forces applied to each area were added.

The entire wing receives a force of 240.72N

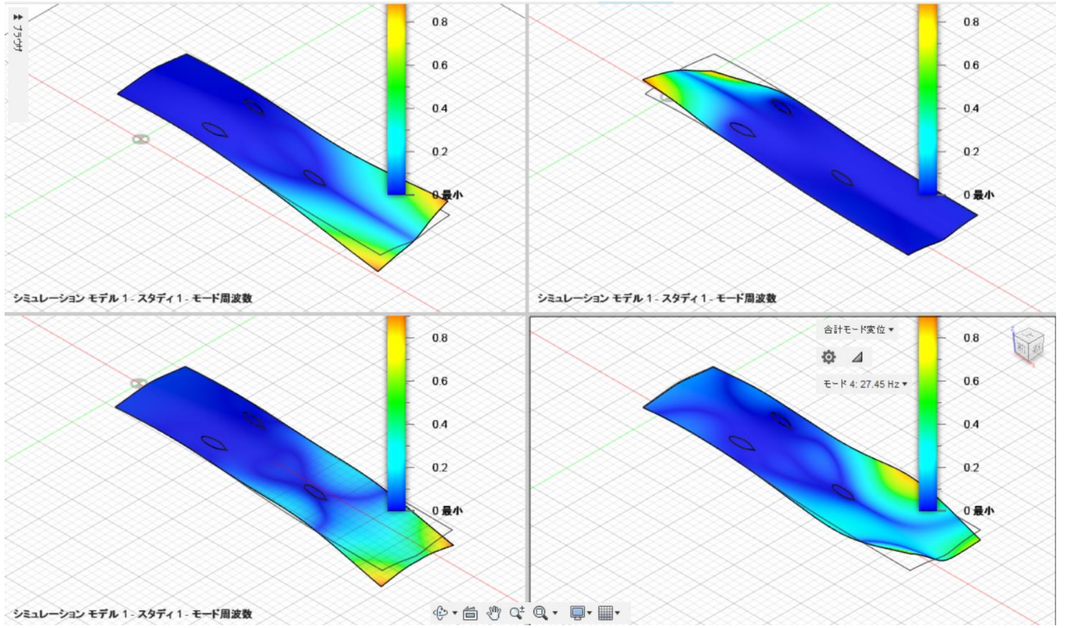
Optimize the placement of UD (CFRP high pitch material)

Flutter phenomenon (Wing will be destroyed?)

Flutter is a divergence phenomenon when elastic vibrations of bending and twisting are coupled with aerodynamic force.
The Bridge and airplane wing is destroyed due to vibrations are amplified and diverged.



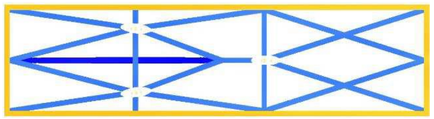
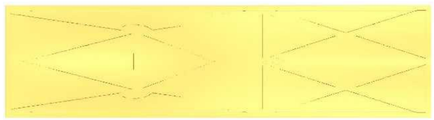
Modal Frequency Simulation

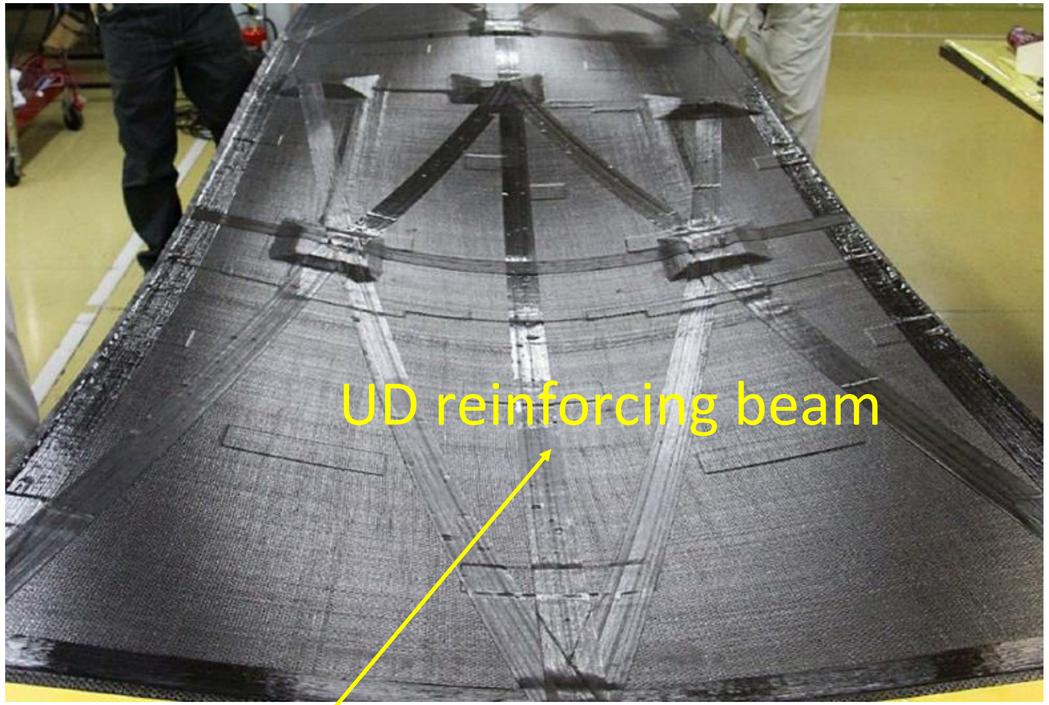


Optimize the placement of UD (CFRP high pitch material)

UD material is used as reinforcing beams to ensure rigidity

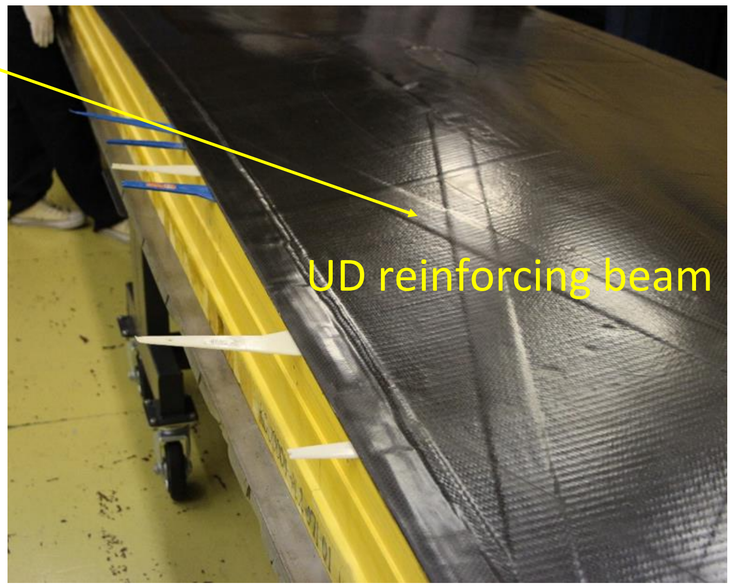
CFRP laminated configuration

種類	配置	ply	厚さ[mm]
CFRP_1K		1	0.07
UD_中弾性		5	1.25
UD_高弾性		1	0.29
CFRP_1K		1	0.07
UD_中弾性		5	0.25
CFRP_3K		1	0.22
UD_中弾性		5	0.25



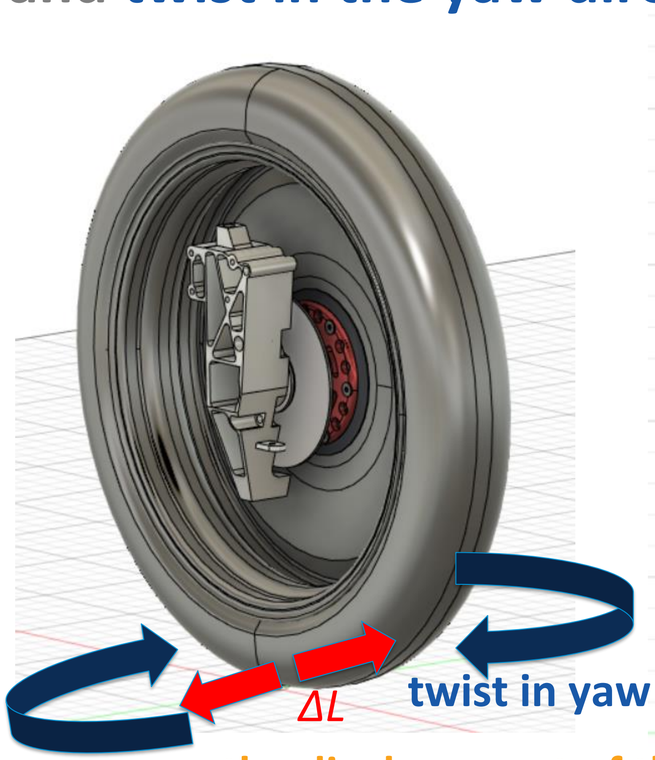
UD(uni direction) CFRP

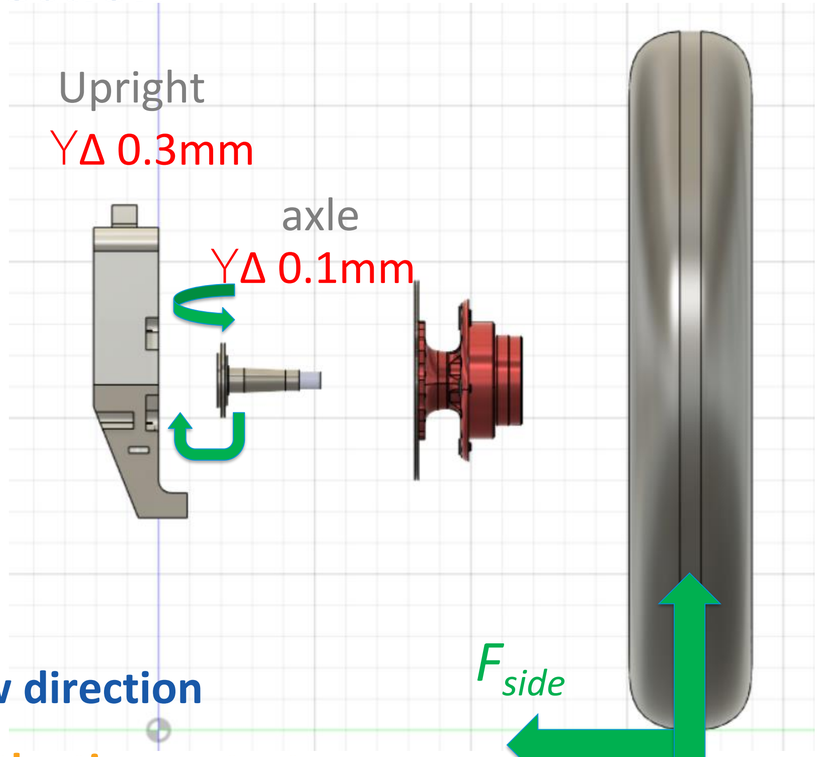
UD is a material with fibers aligned in one direction.
Strength and rigidity are only in the fiber direction



What is goal of optimization?

Minimize the displacement of the tire contact area and twist in the yaw direction





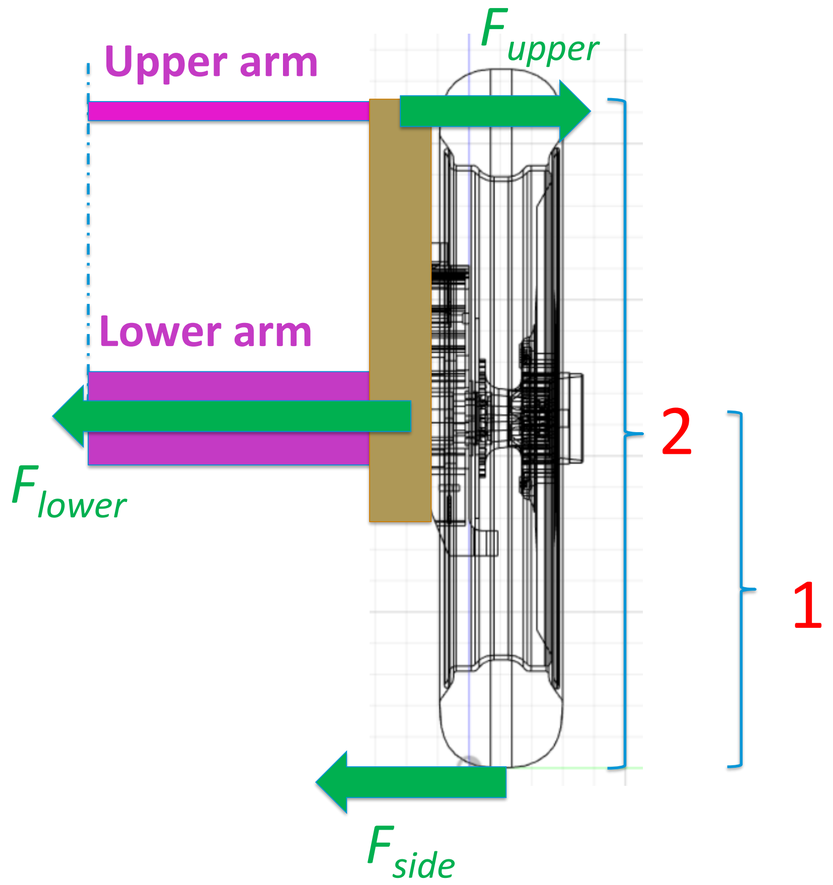
the displacement of the tire contact area

Example parameterization

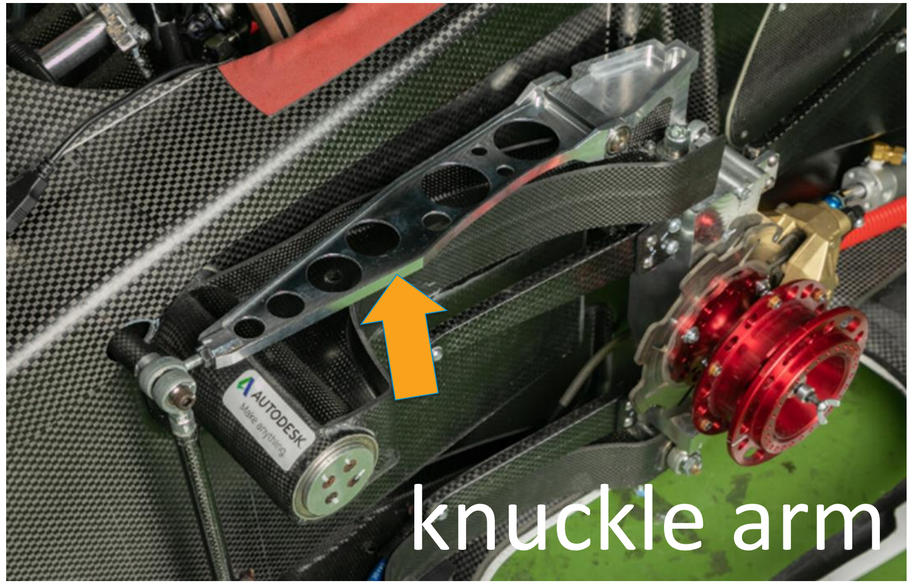
axle	+10g	displacement -0.1mm
upright	-20g	displacement +0.1mm
	-10g	0mm

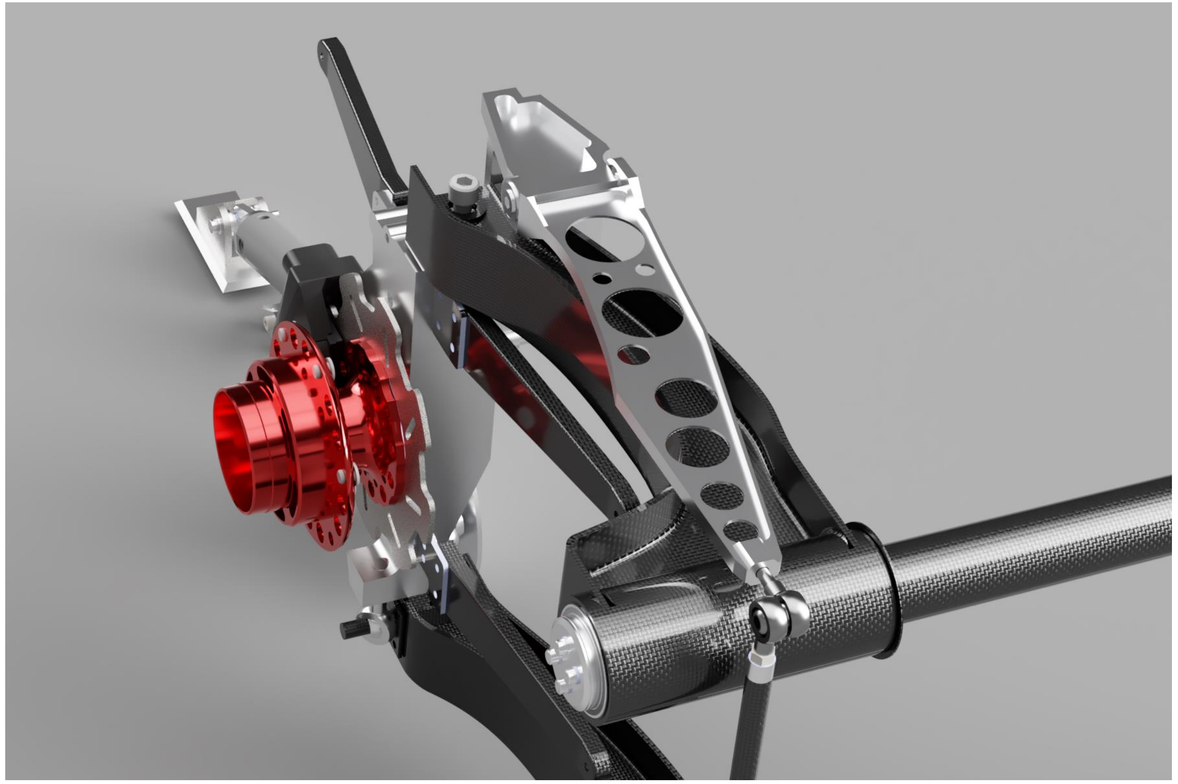
MEMO: Arm stiffness

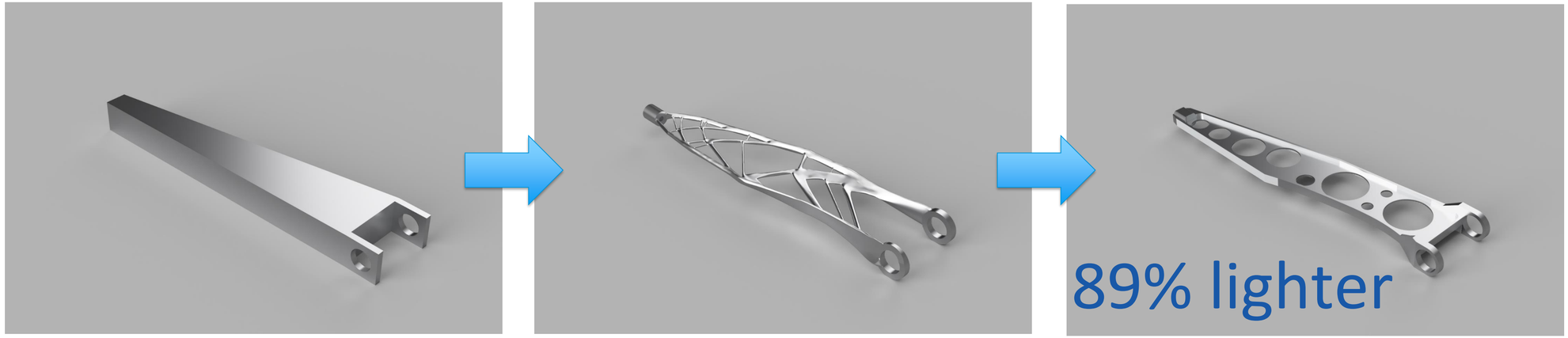
Lower arm >> Upper arm



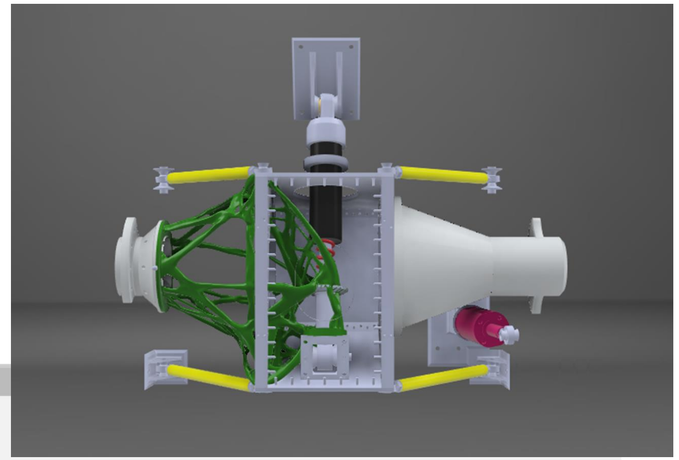
Generative Design

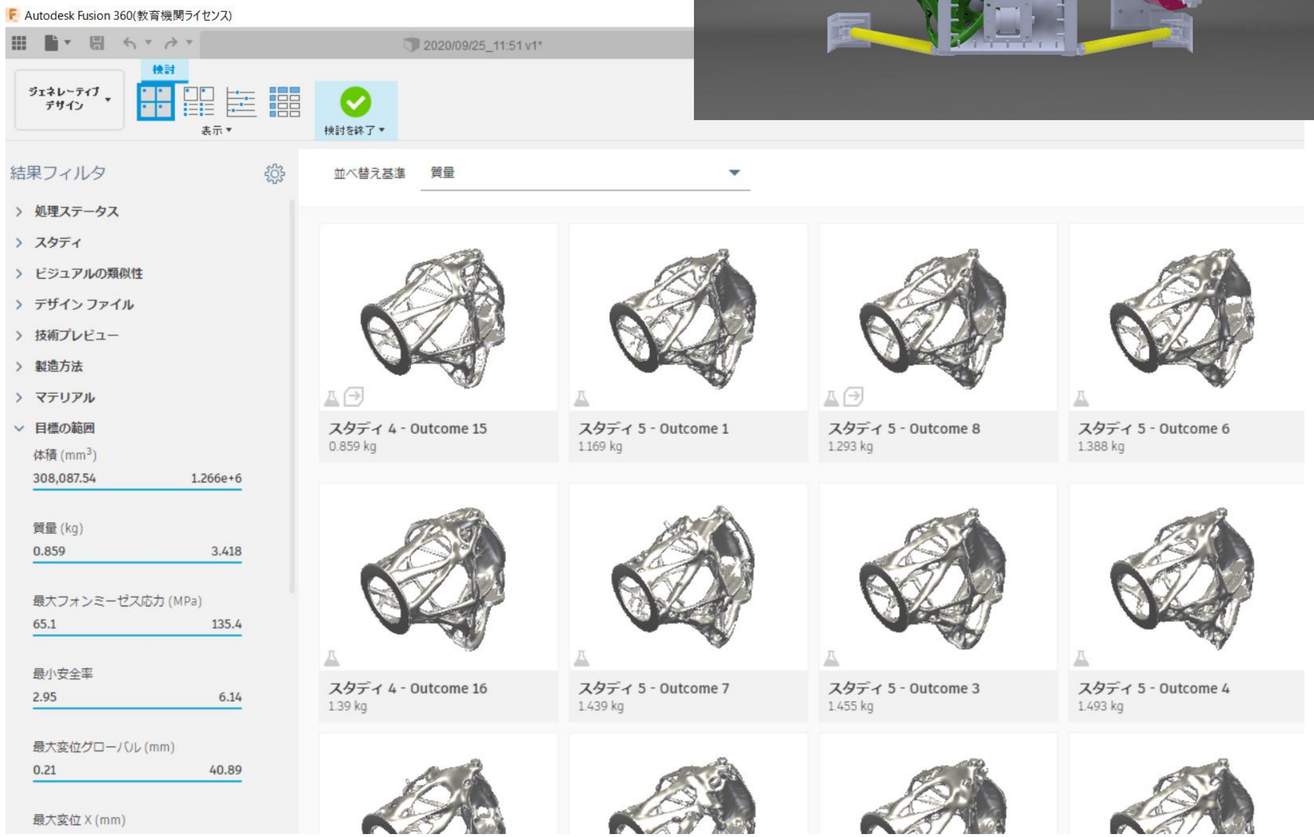


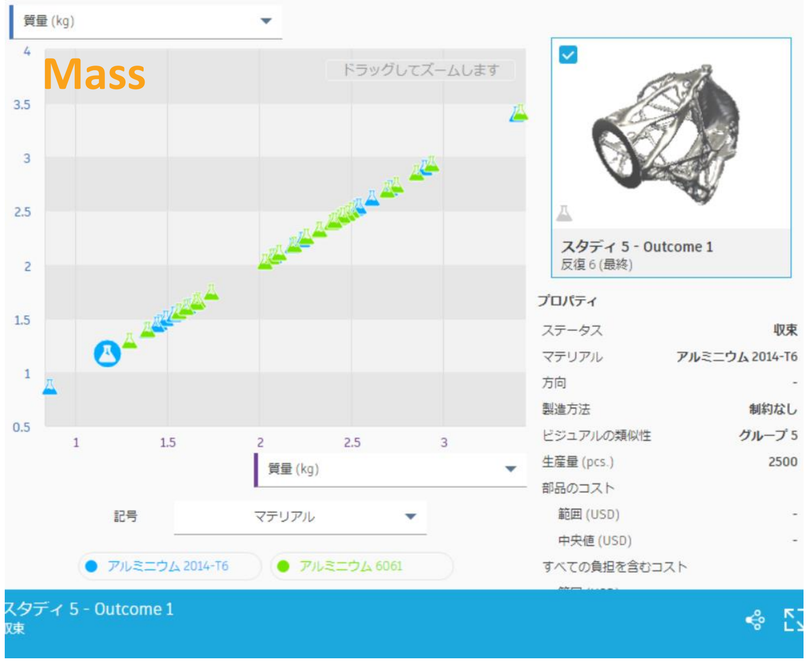


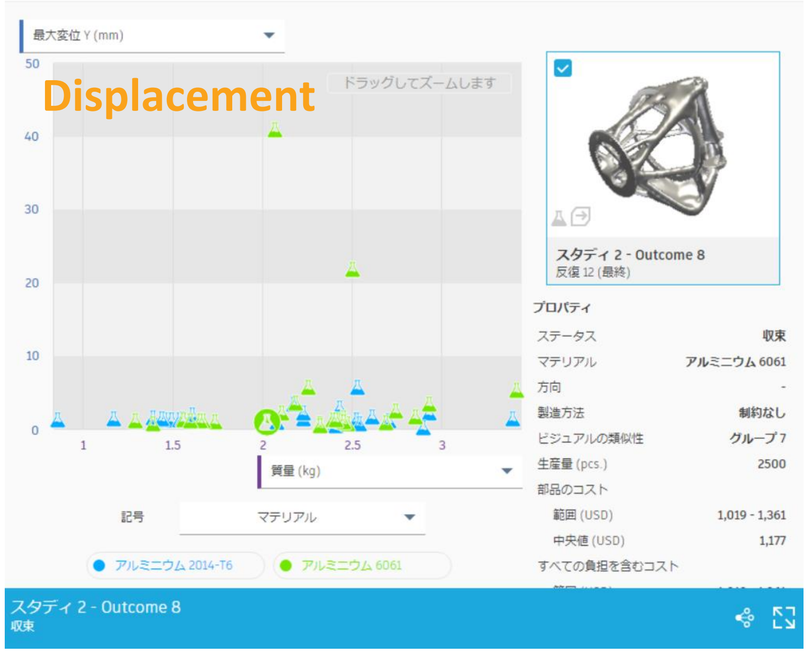


Generative Design

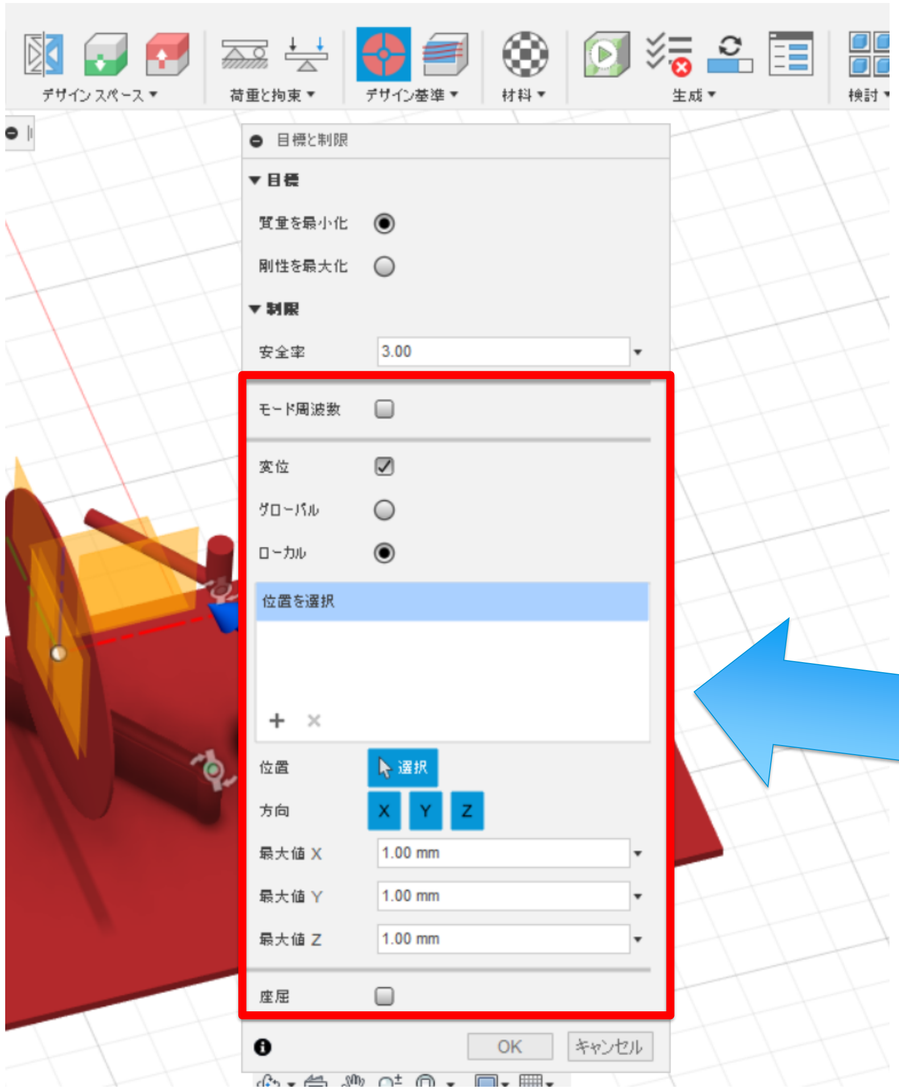


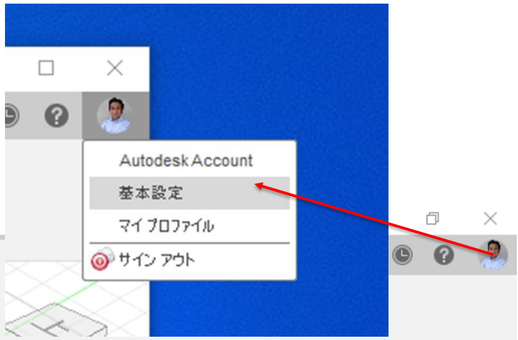


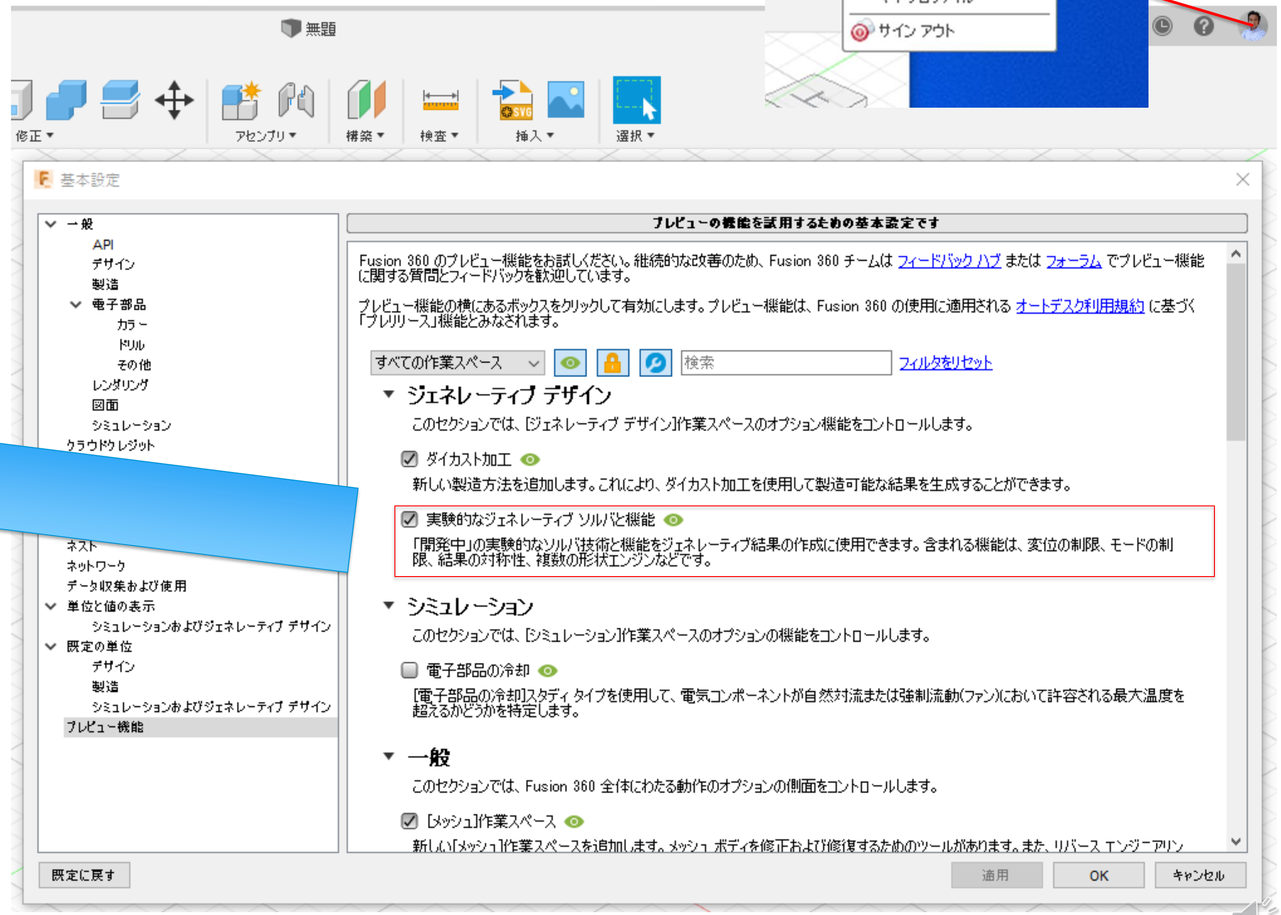




Advanced setting for Generative Design





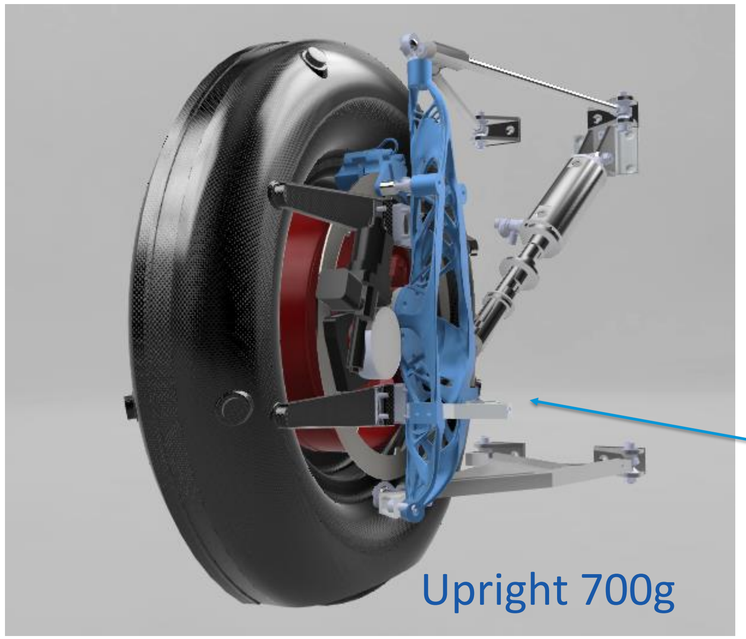


Samples of our past cars

5th car
Rear
Swing Sus

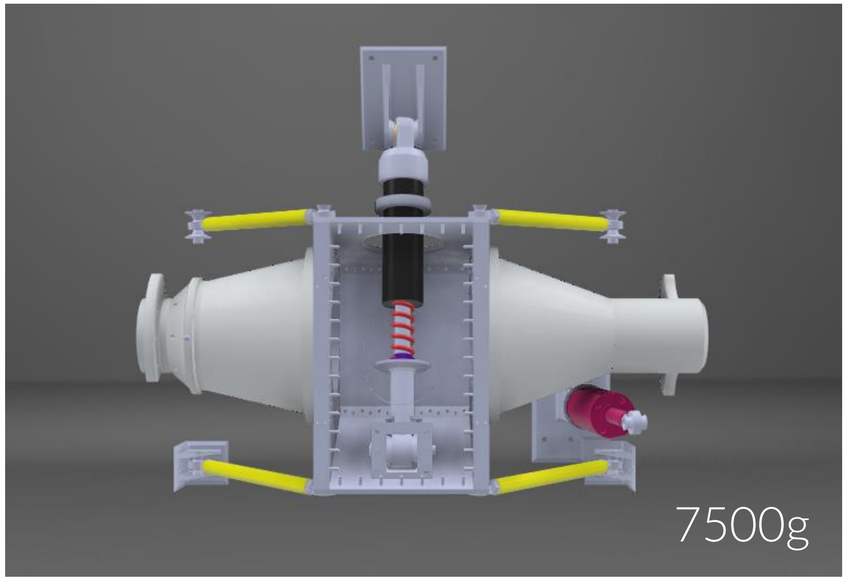
lightweight

-36%



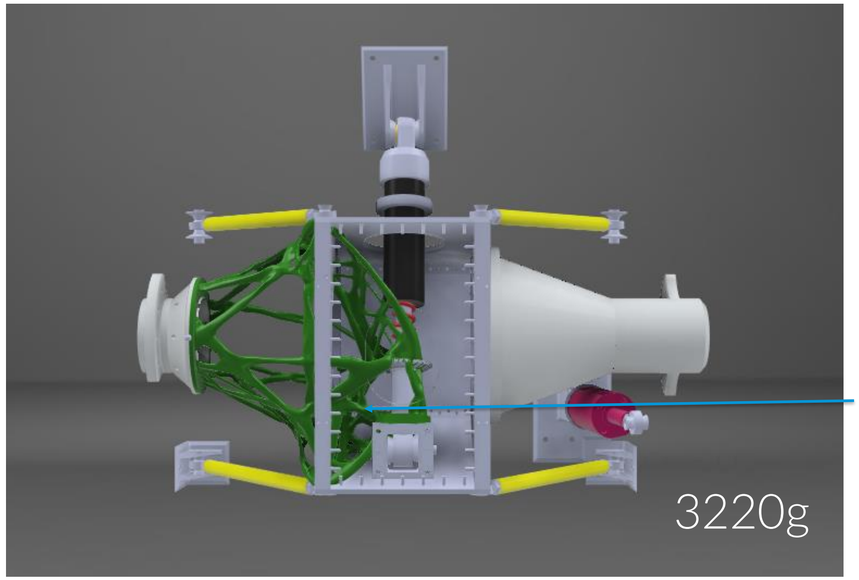
Lower parts
High rigidity

4th car
Rear
Rigid Sus



lightweight

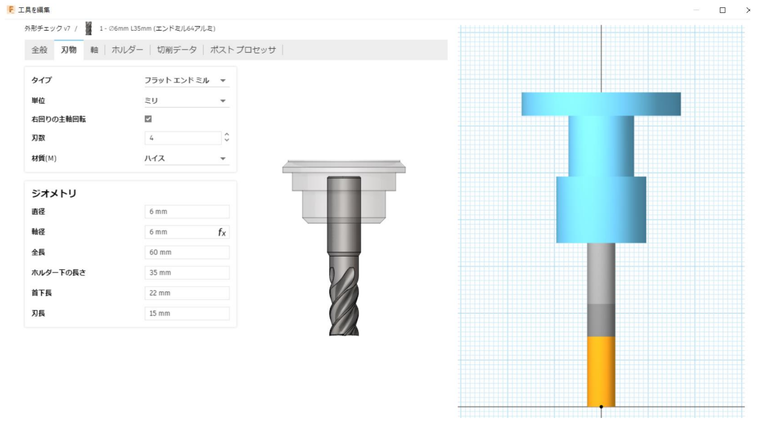
-57%

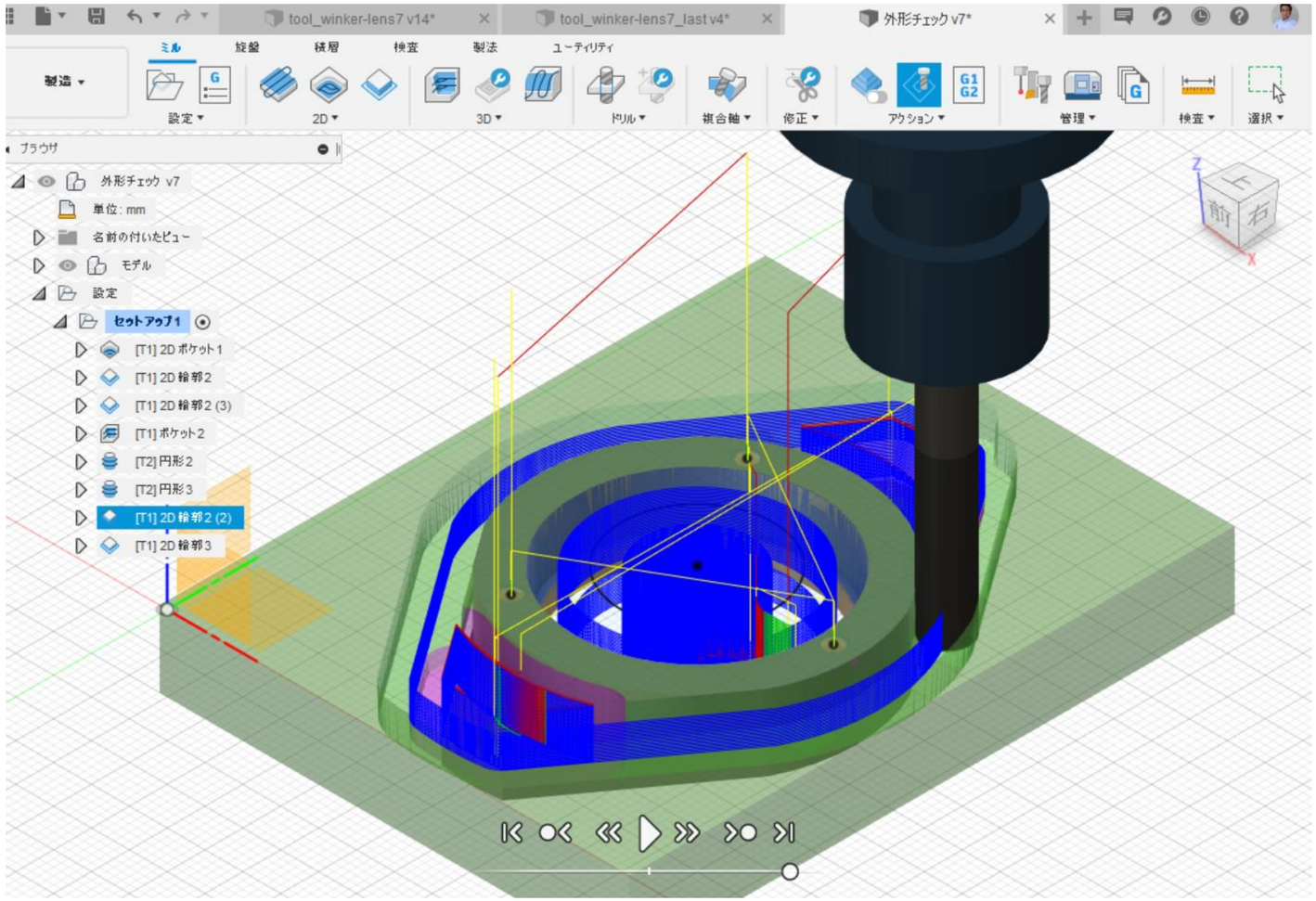


Lower parts
high rigidity

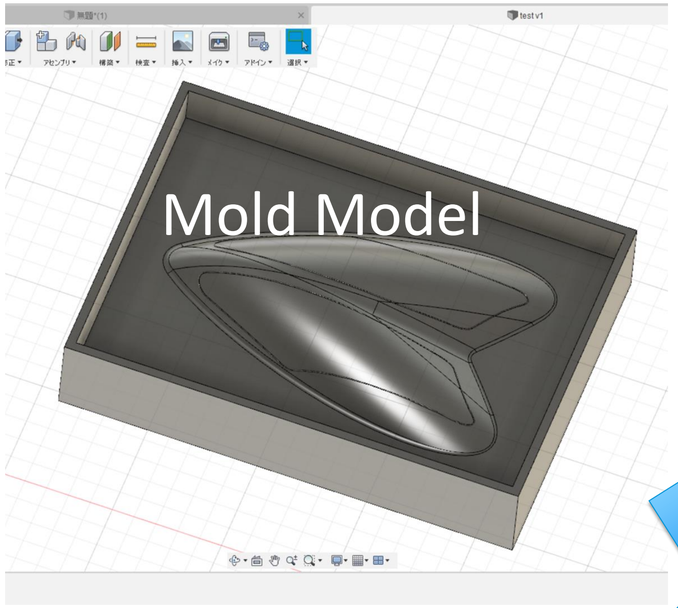
CAM with Fusion 360

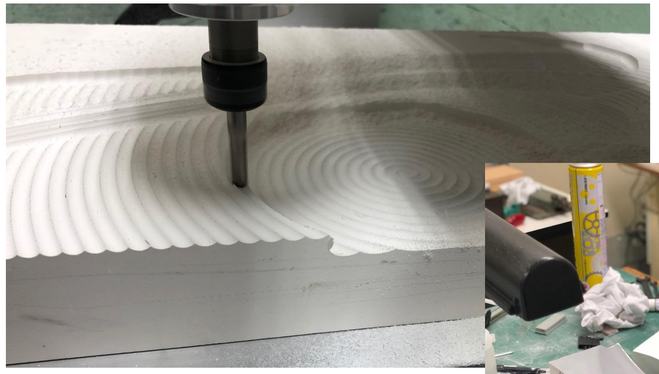
1/13 time reduction





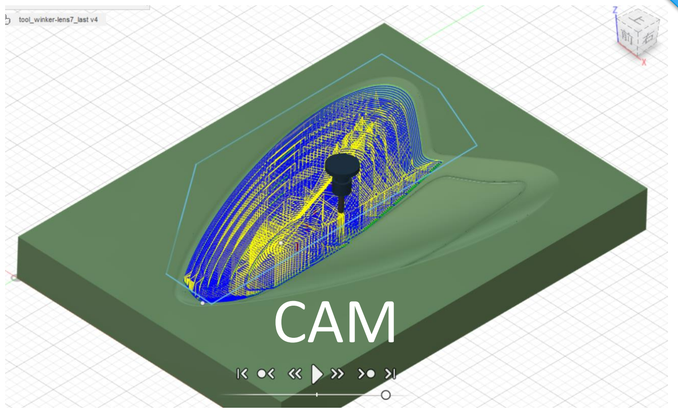
CAM for Mold, CFRP, Polycarbonate and PET





Mold making

Thermoforming

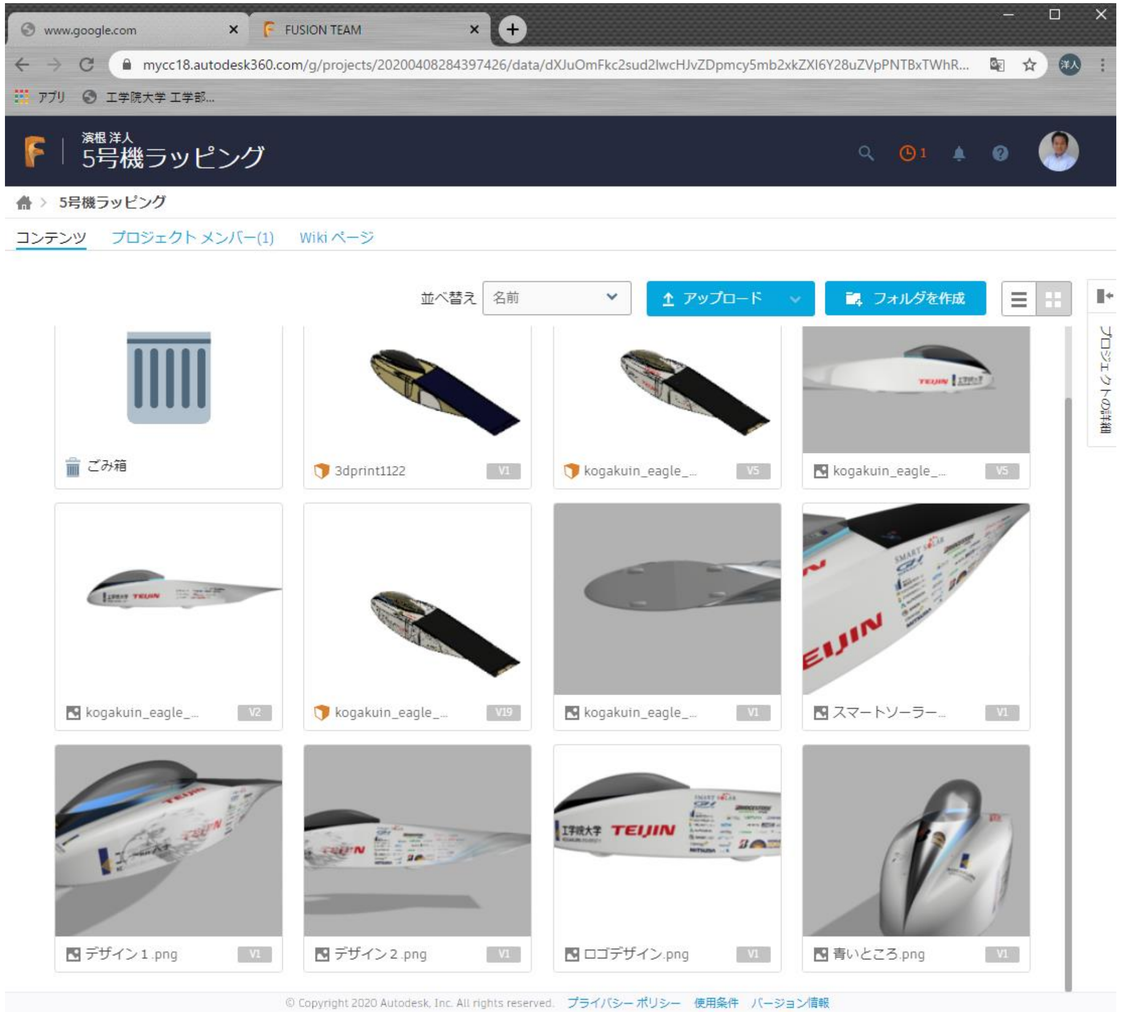


Laminate CFRP

Rendering: Car wrapping proposals

Rendering for beautiful posters

Publish the proposal to members on the WEB



AUTODESK®
FUSION 360

Realization

The realization of CAD data is our greatest pleasure. Enjoy!!