

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.



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



KUTE-TOKYO
Kogakuin University of
Technology & Engineering



Generative Design

● パーツ軽量化

89% lighter



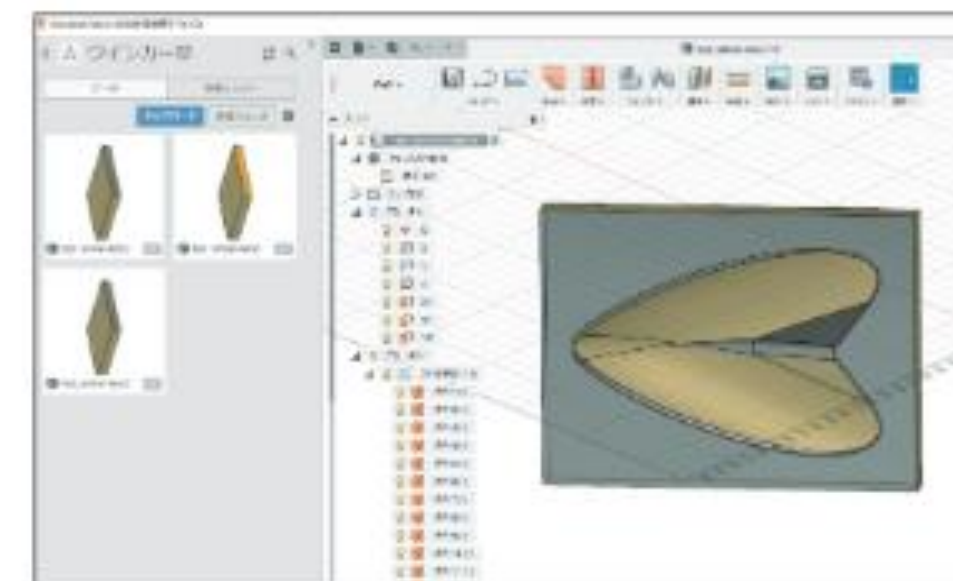
CAM

● オリジナル金属パーツの切削

1/13 time reduction



Team management, Data migration



Rendering



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**.



《Competition Details》

Bridgestone World Solar Challenge
Australia from Darwin to Adelaide, 3000km
Date: October, every two years
Organizer: South Australian Tourism Commission

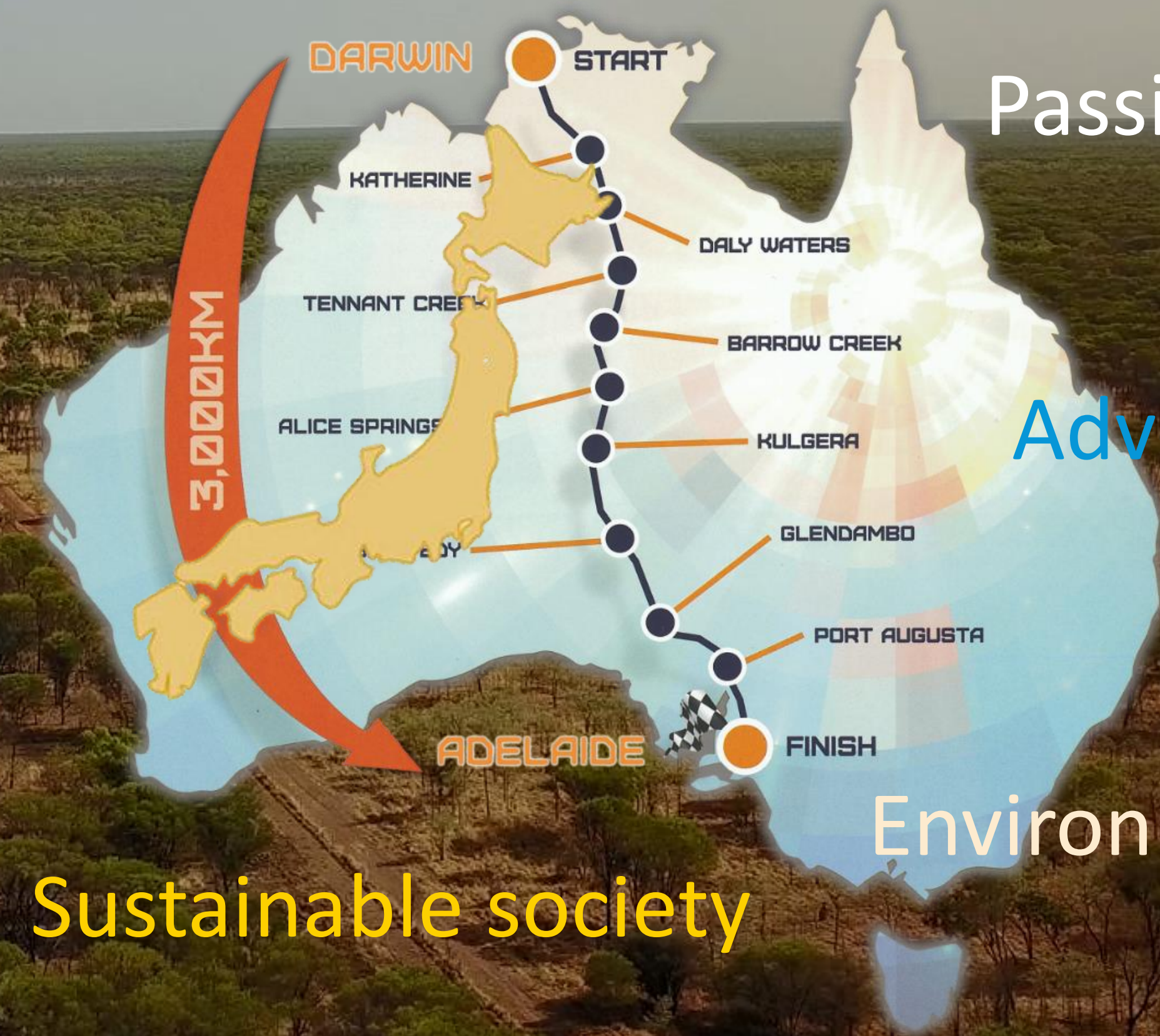
Innovation

Passion

Adventure

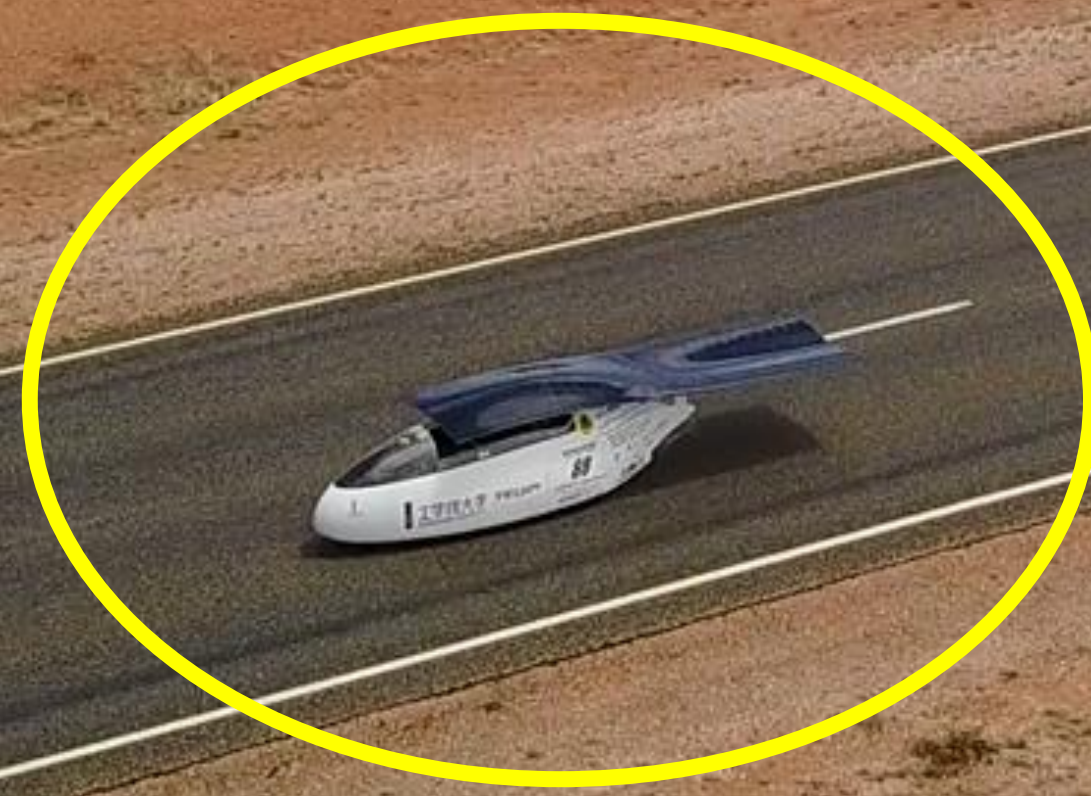
Environment

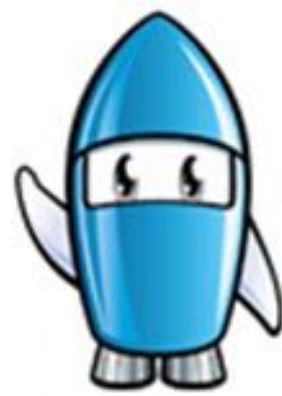
Sustainable society



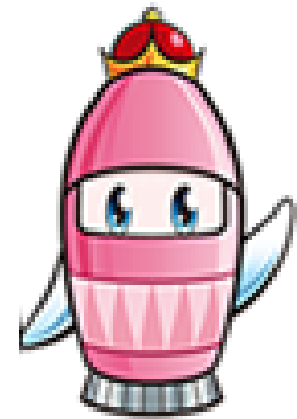
Only 1000W solar panel

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.**

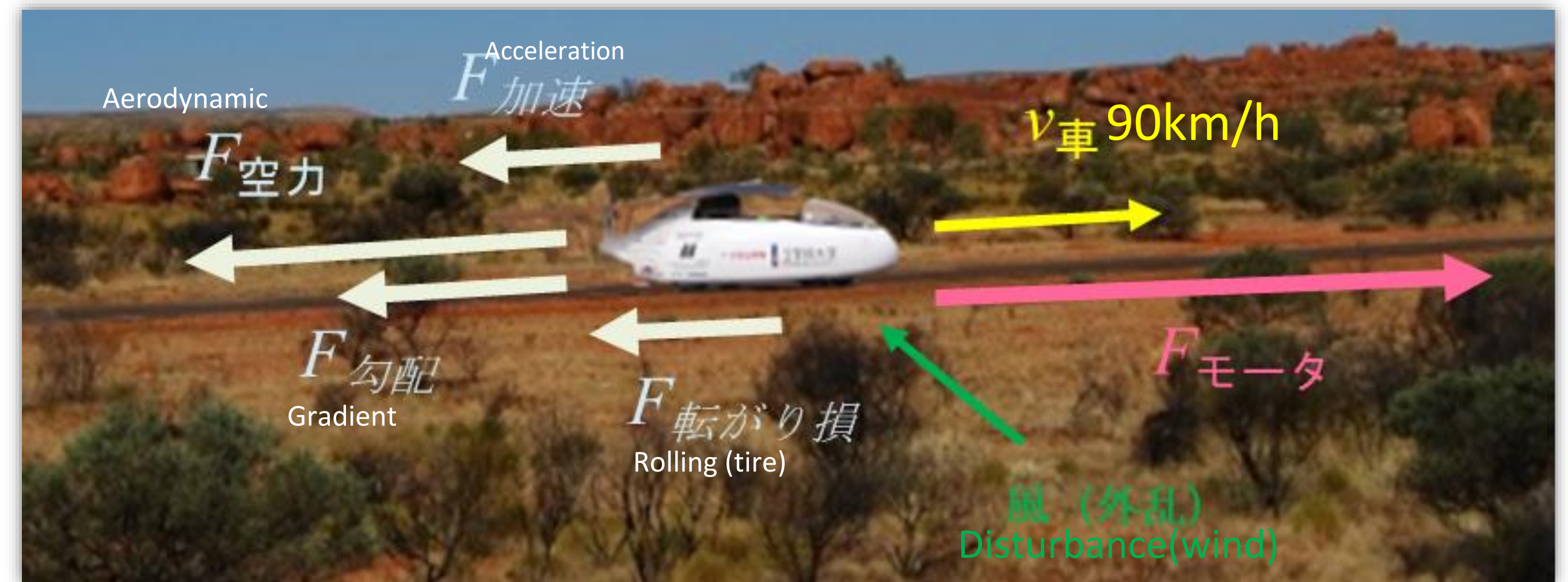
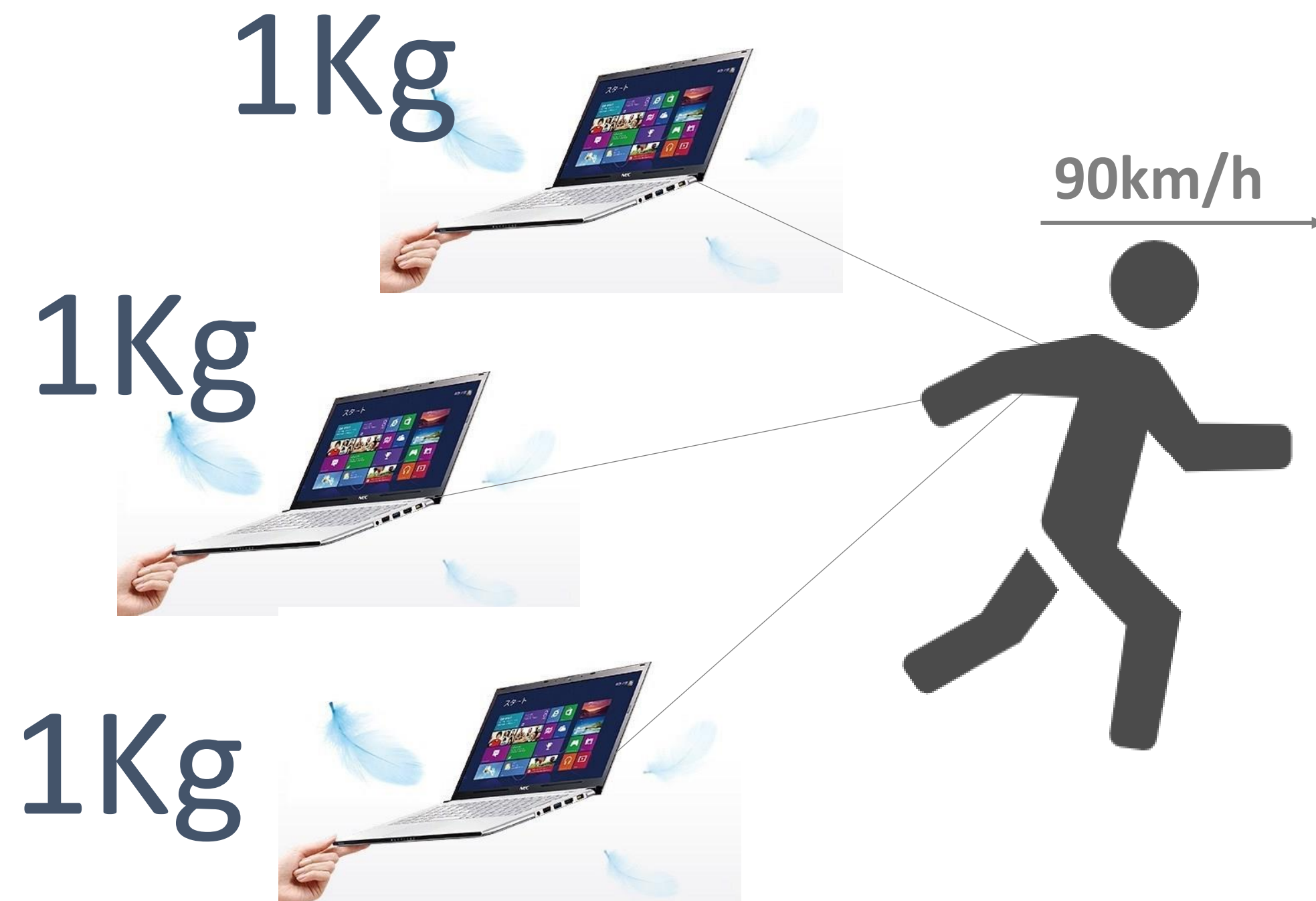




Q: How many kilogram-force does the total running load balance when traveling at 90 km / h?



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)



The forth car (2017) : Biomimetics, Nature morphing

Innovation and Philosophy

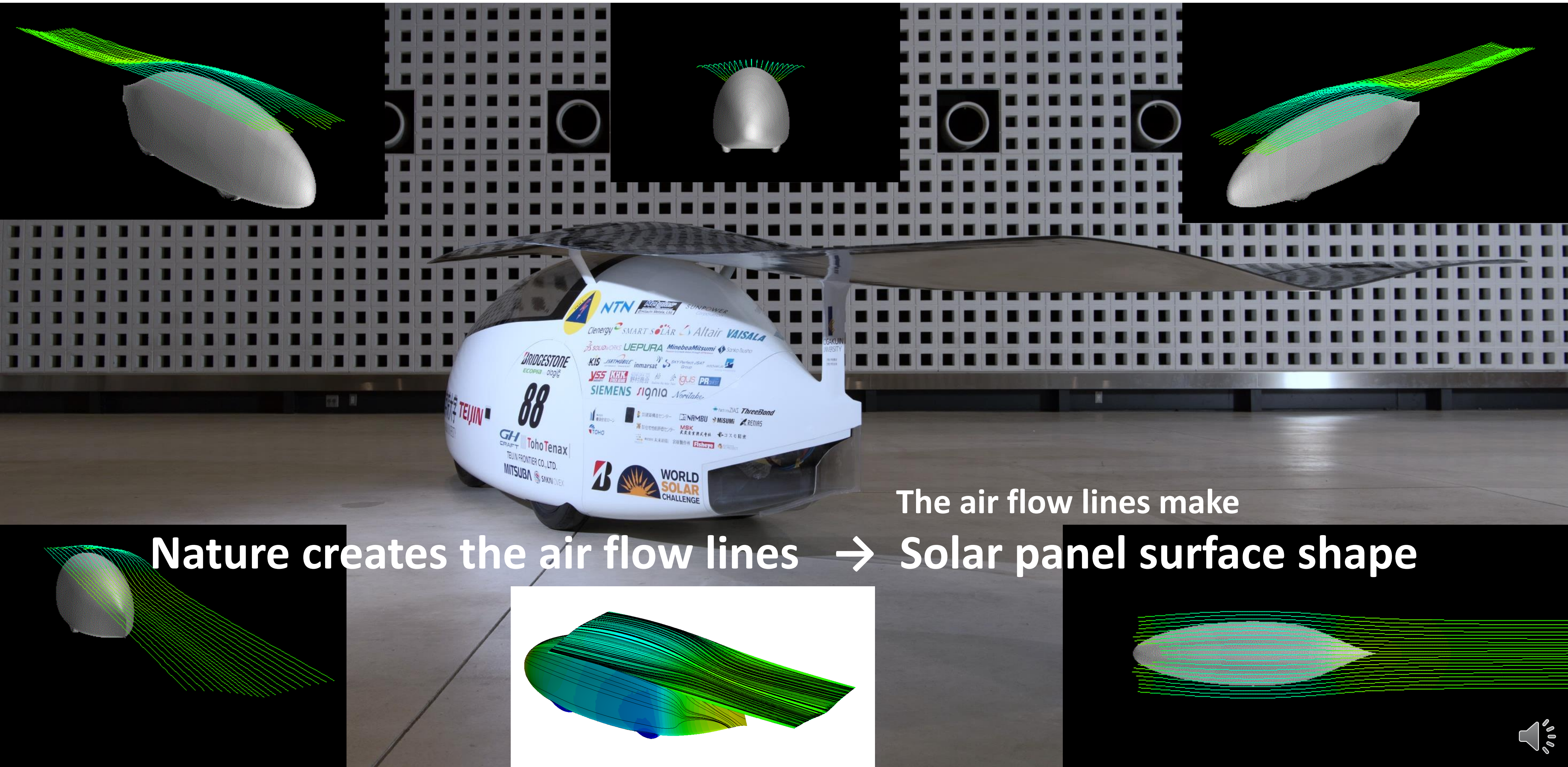
Very thin wing



Car name: WING

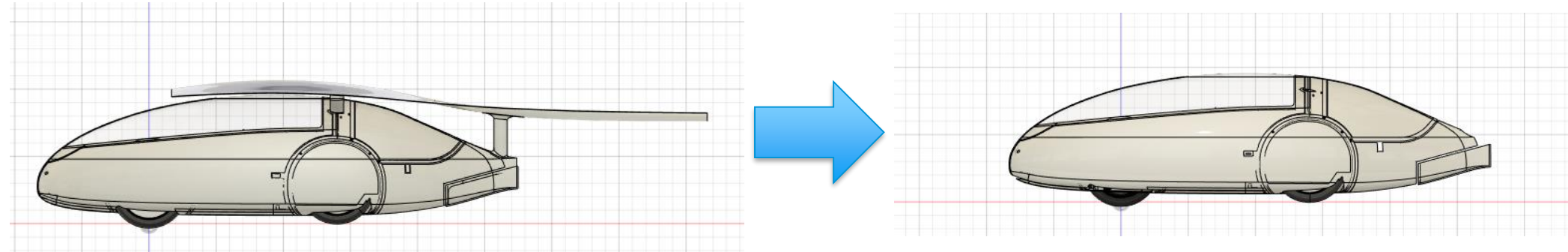


The forth car (2017) : Biomimetics, Nature morphing



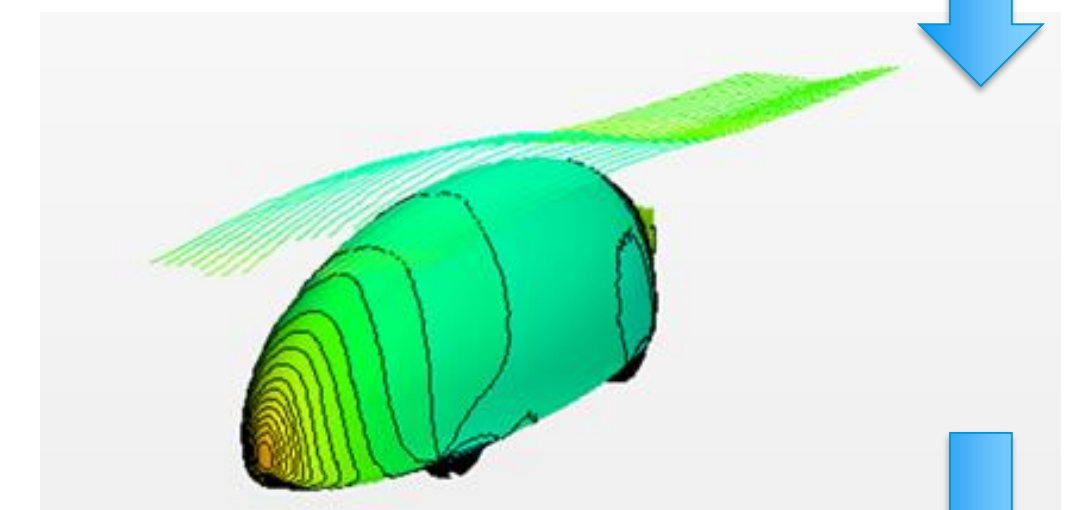
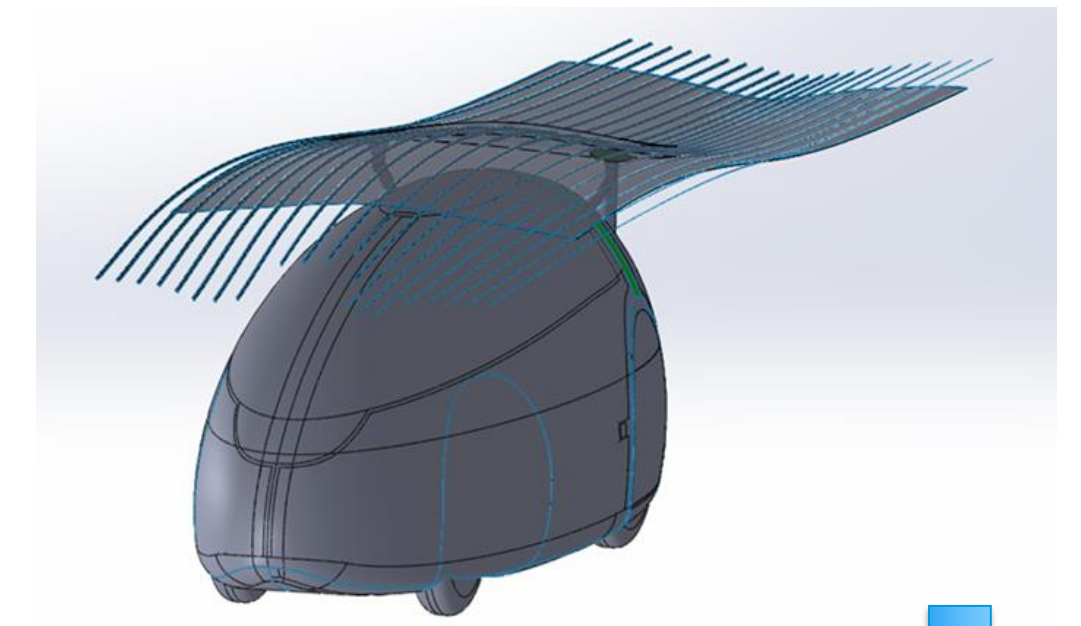
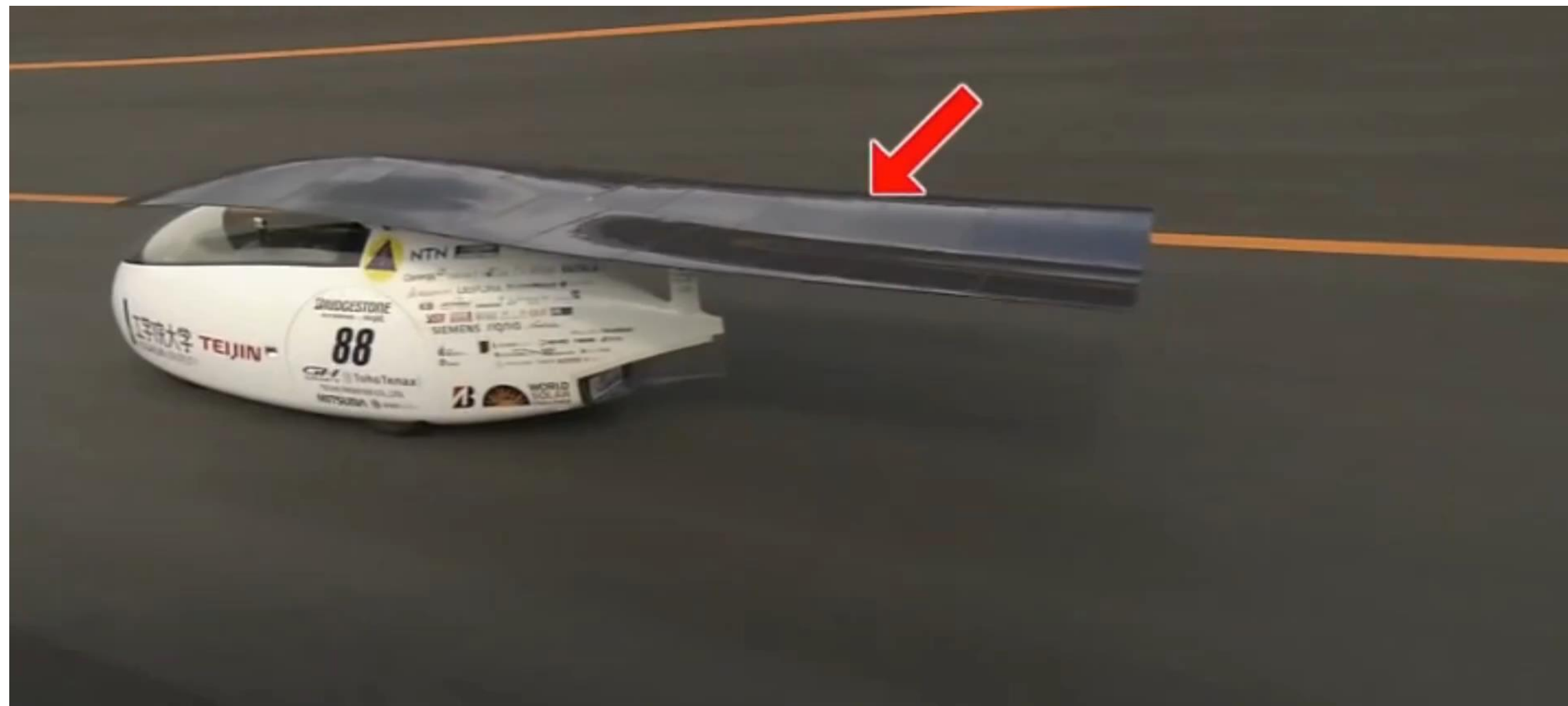
The wing may disappear !?

The idea :

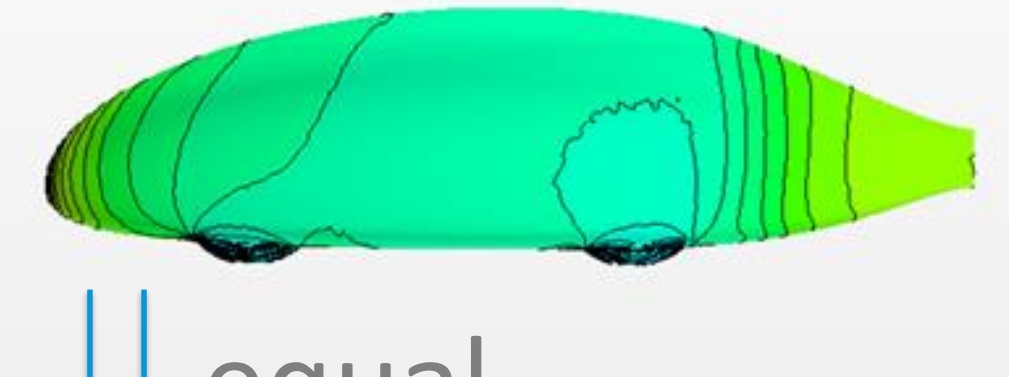


The wing disappear at the target speed !!!???

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



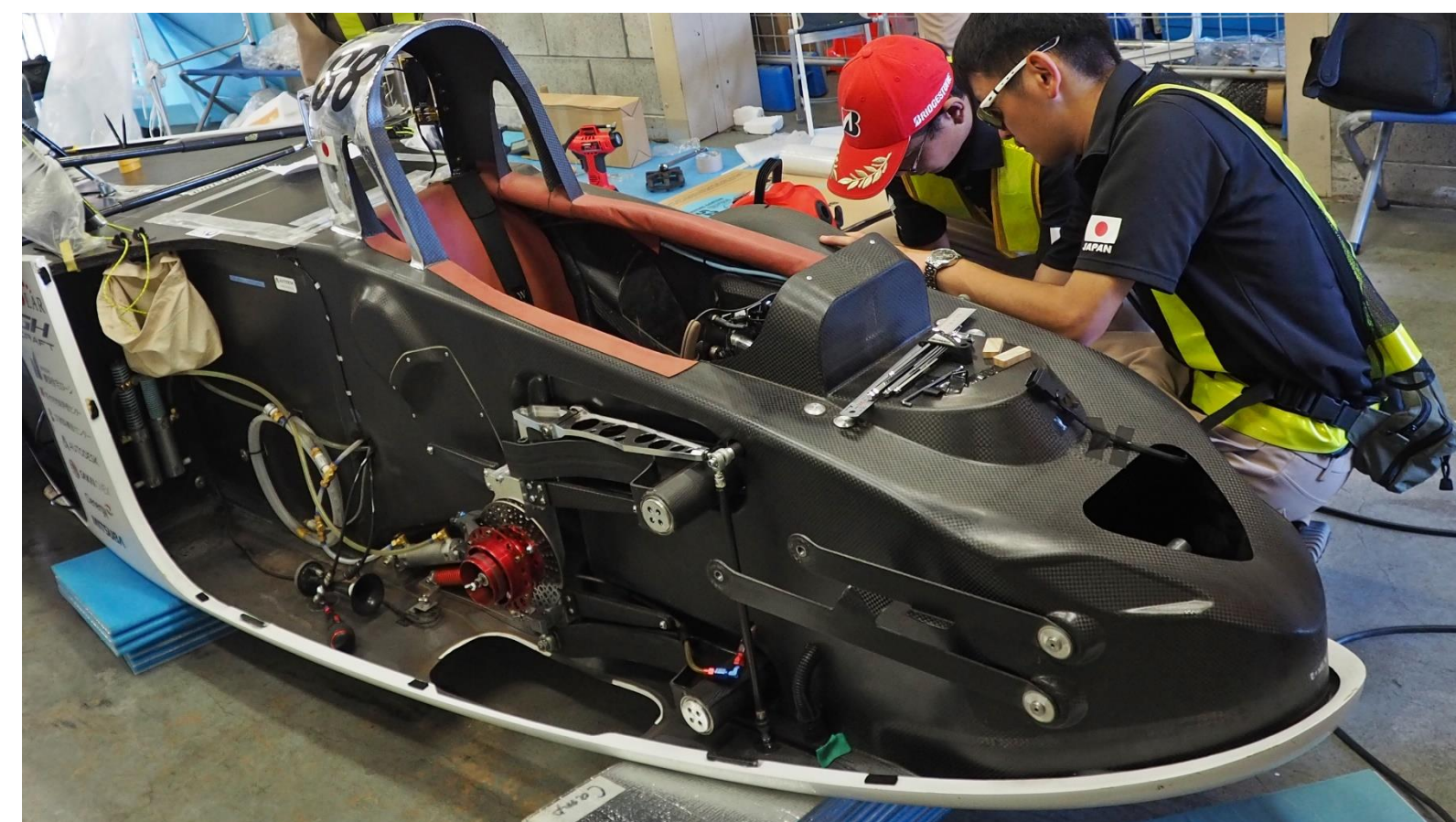
disappear



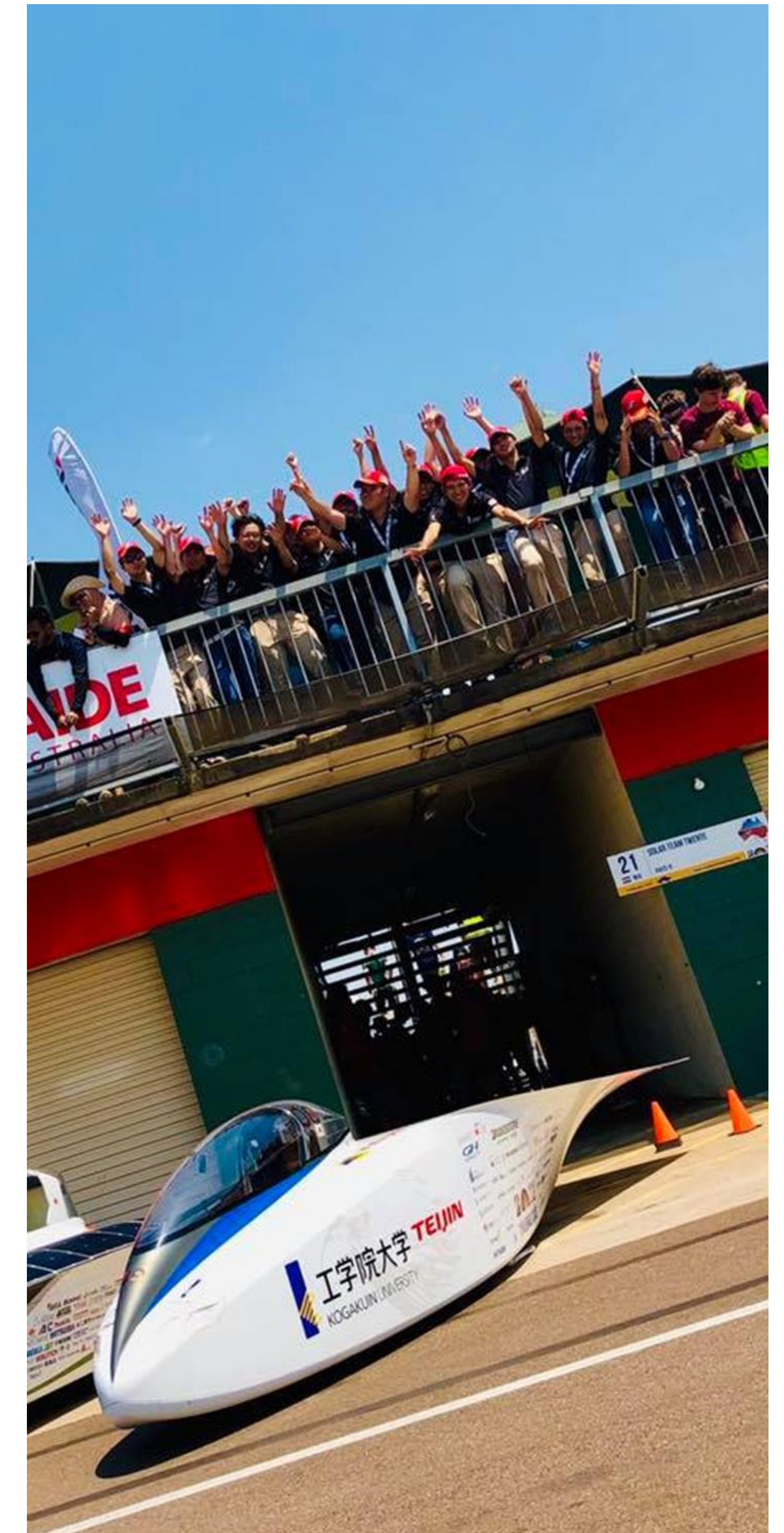
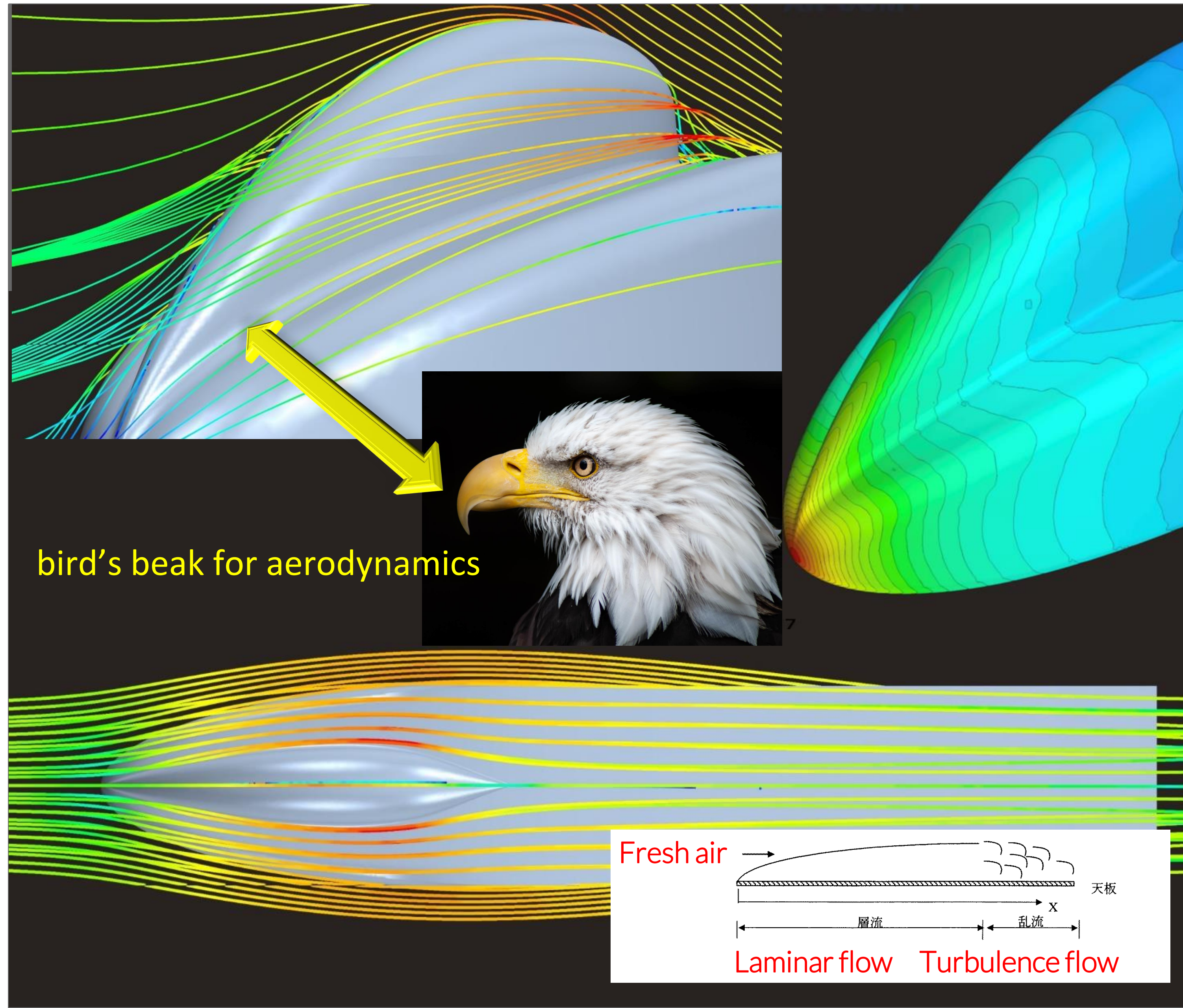
equal



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.



WINNER

**TECHNICAL INNOVATION
KOGAKUIN UNIVERSITY**



Organization and management with Fusion 360



Student

300 students

(Under graduate 300 + Graduate 6)



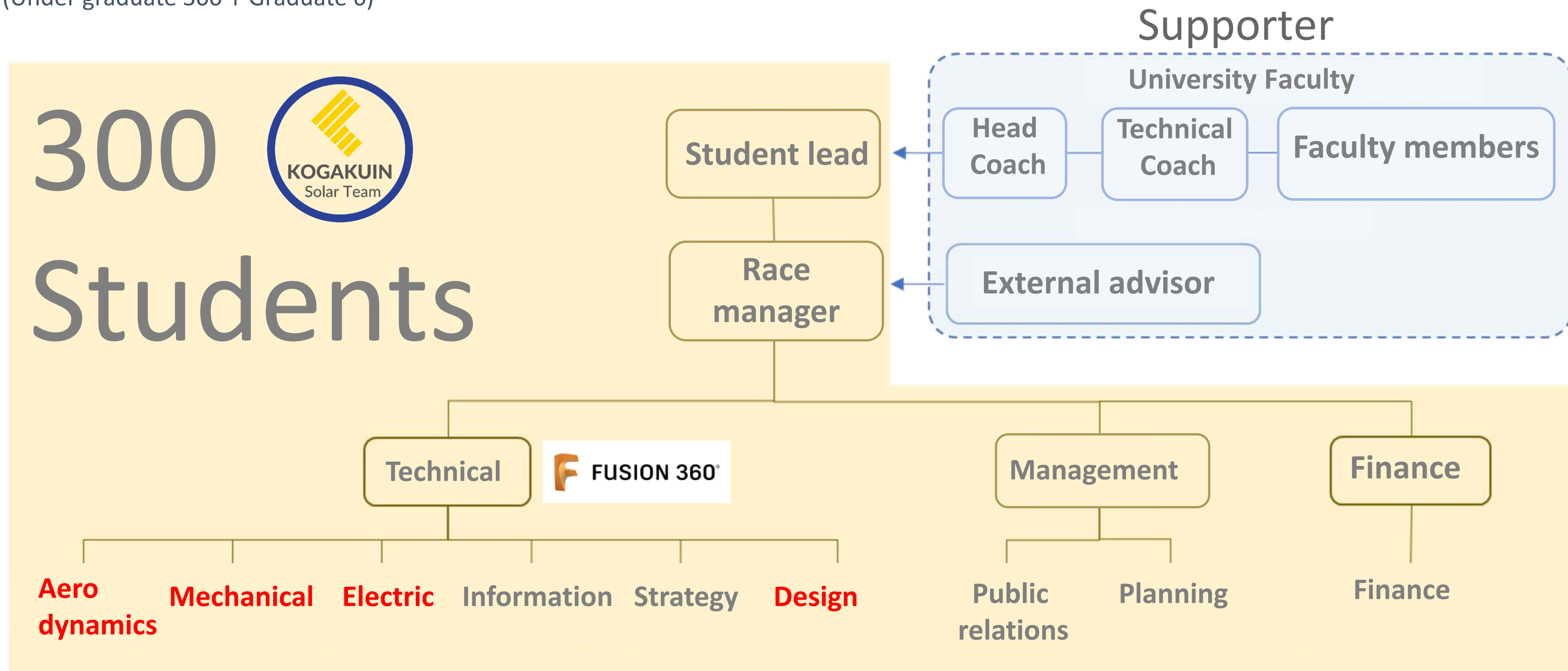
All departments

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



 AUTODESK®
FUSION 360
+
Fusion team



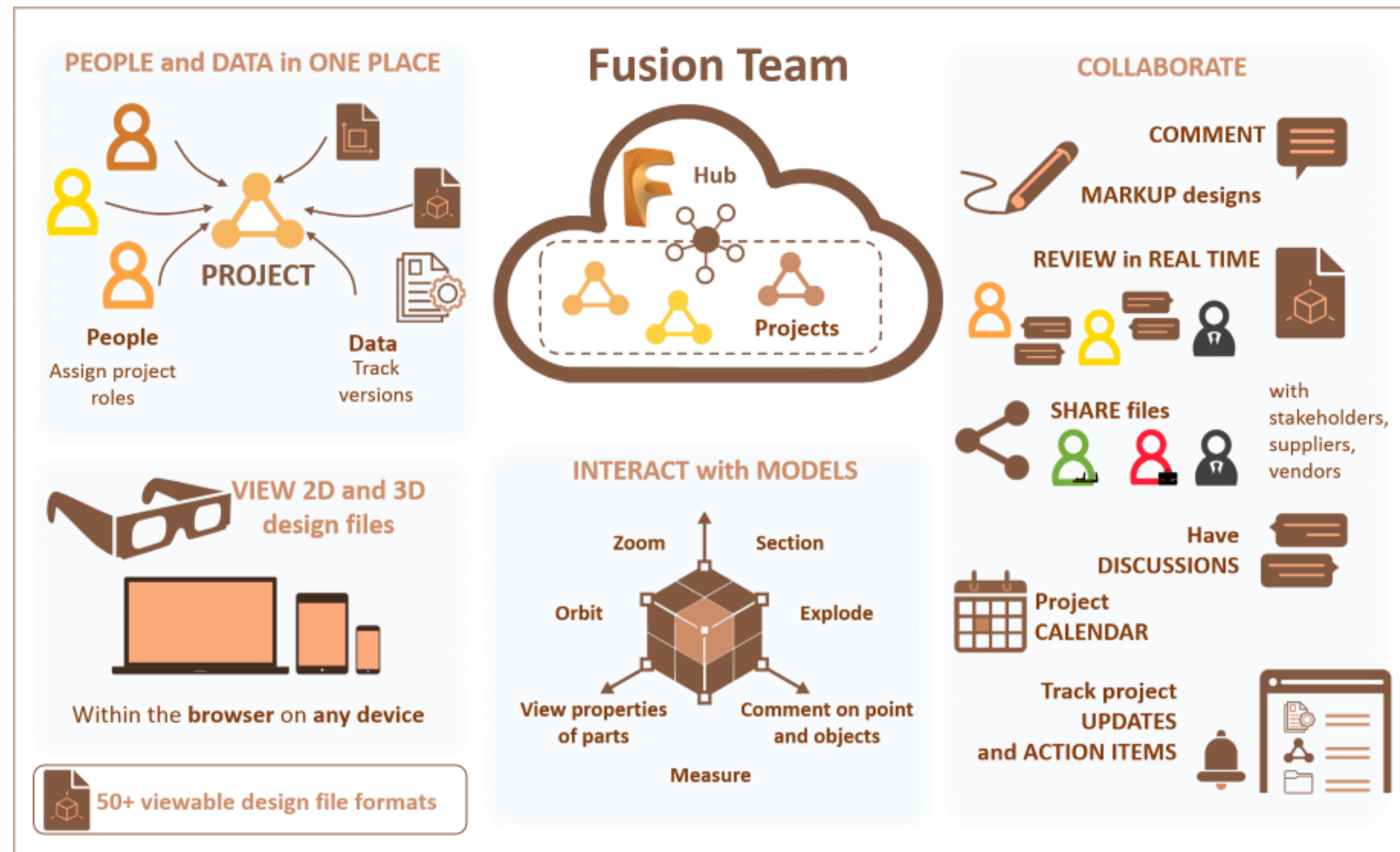
own personal computer
Don't take it all on yourself.



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>



Team account: Add people to your projects

The screenshot shows the Fusion Team web interface. At the top, the user '濱根 洋人' (Hamane Hiroto) is logged in. Below the header, there's a table listing team members. A large, semi-transparent box labeled 'Private mail address' is overlaid on the left side of the table. The table columns are '名前と電子メール' (Name and email), 'タイトル' (Title), '会社' (Company), and '役割?' (Role?).

名前と電子メール	タイトル	会社	役割?
Hamane Hiroto	Professor, Dr.Eng.	Kogakuin University	プロジェクト管理者
佐僚			編集者
直松			編集者
雄早			編集者
哲石			編集者
直大			編集者
X6			編集者

- 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



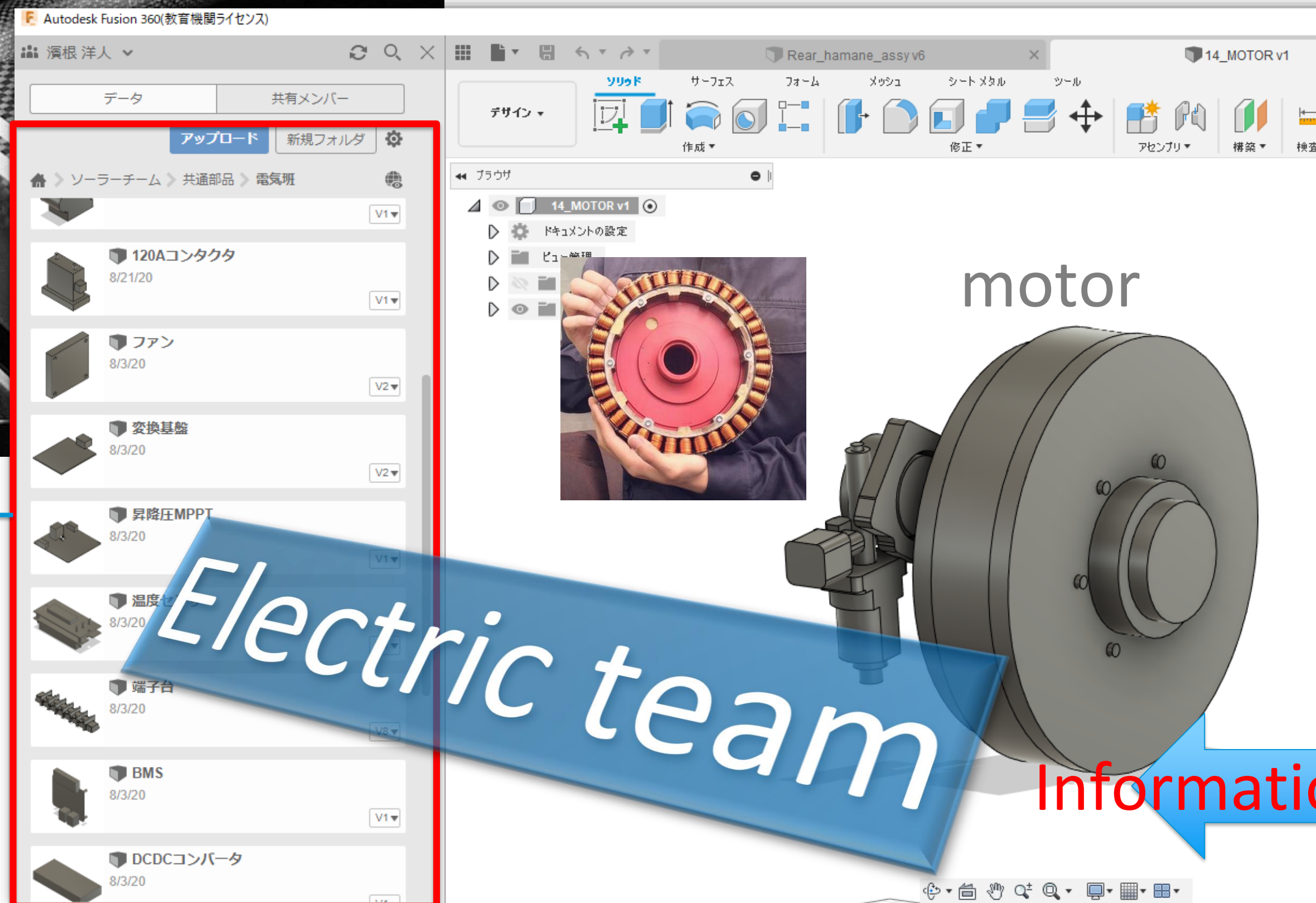
Solar Team's Common Parts

For your information (FYI)

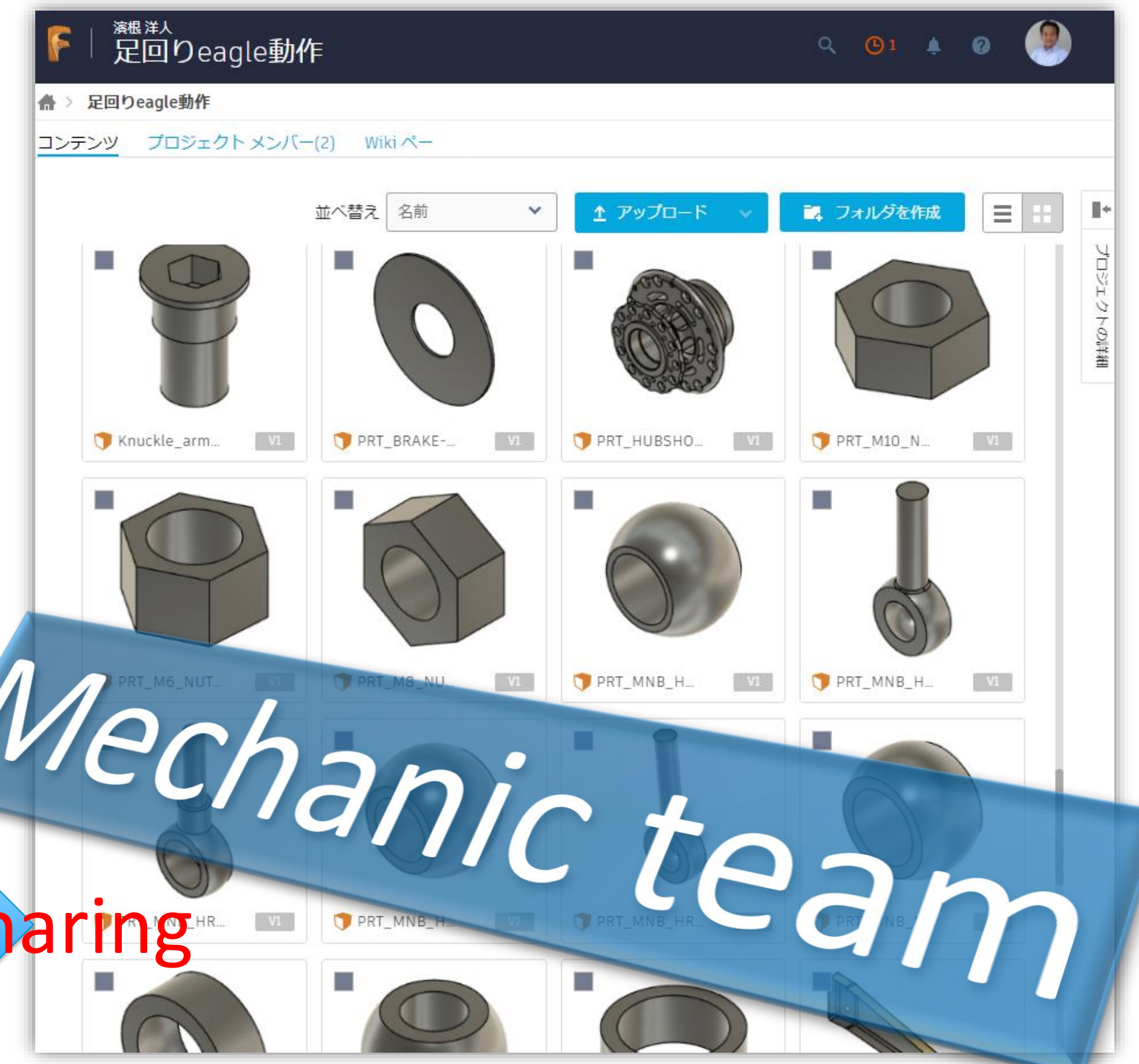
Information can be shared *between different departments*.
Sharing has become more widespread.

Electric parts

Mechanic parts



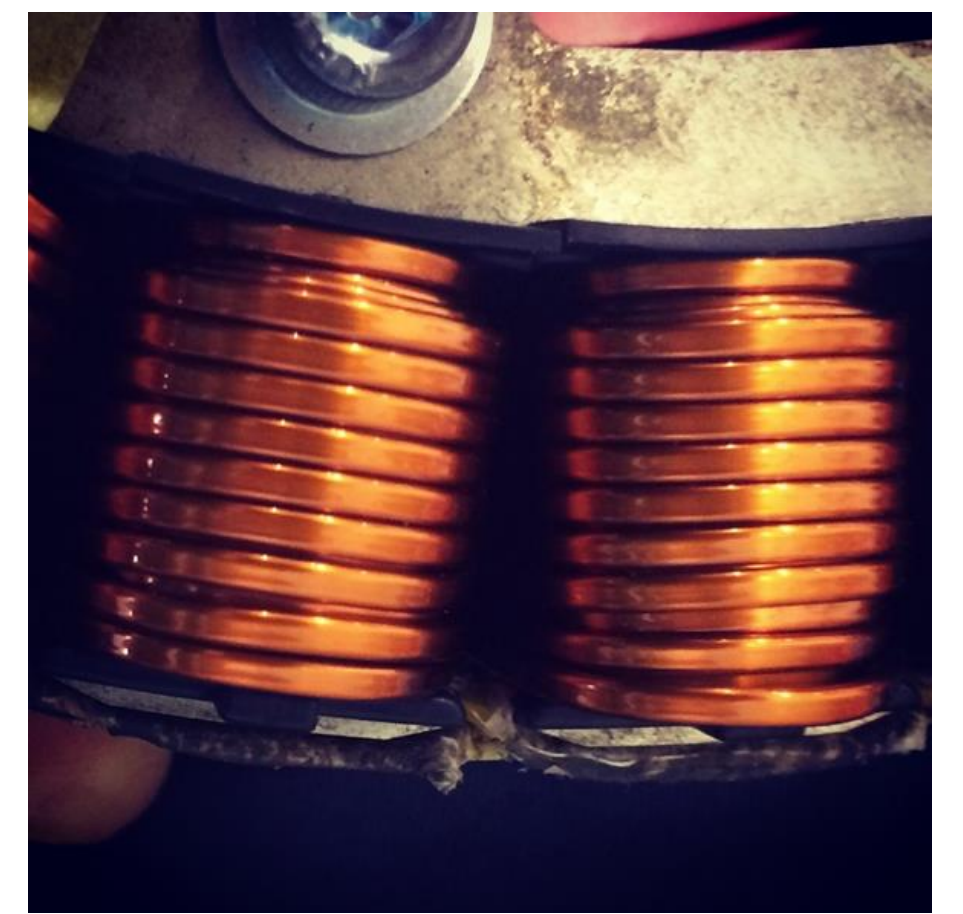
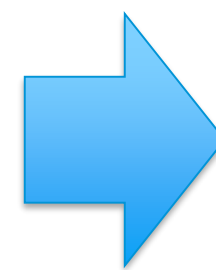
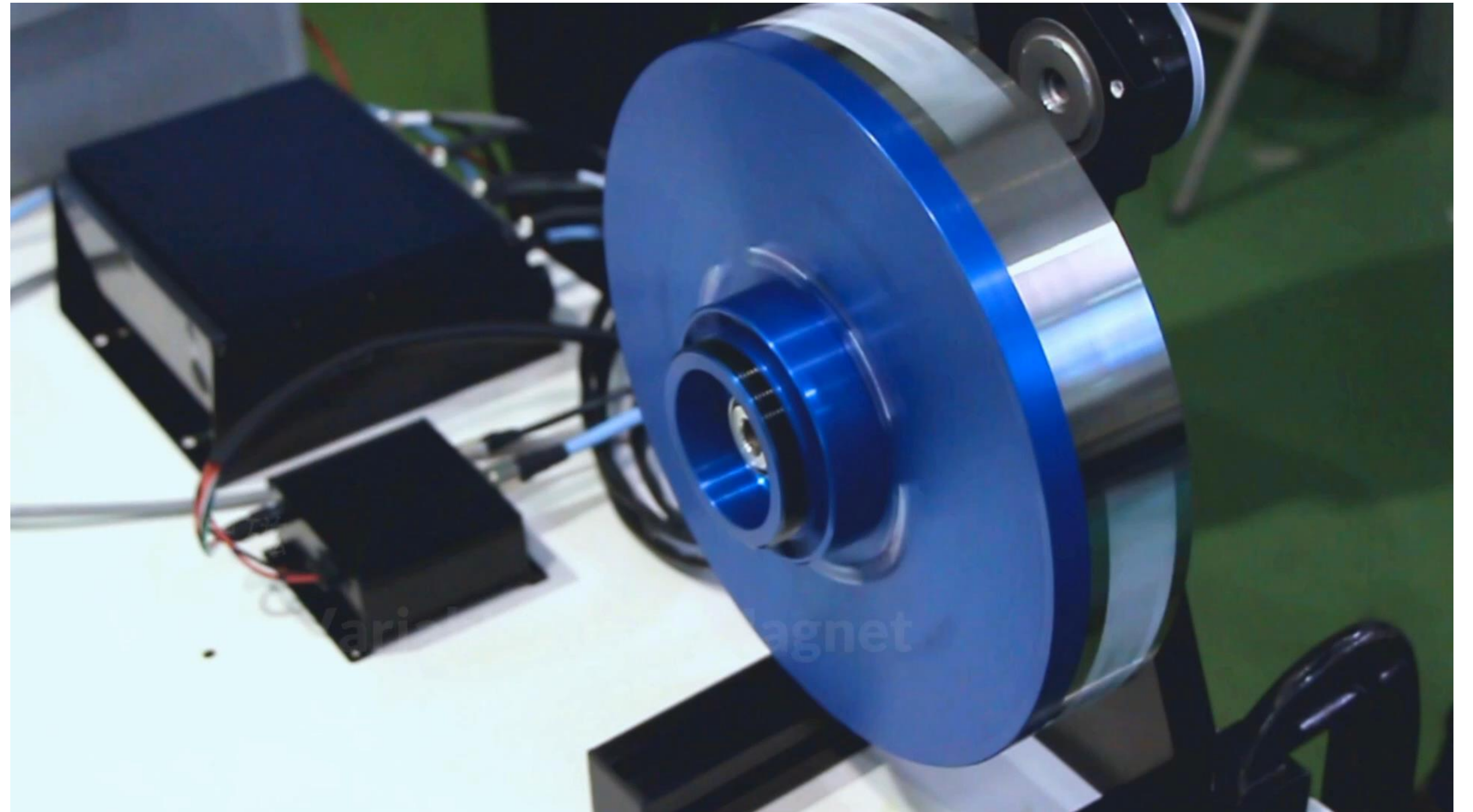
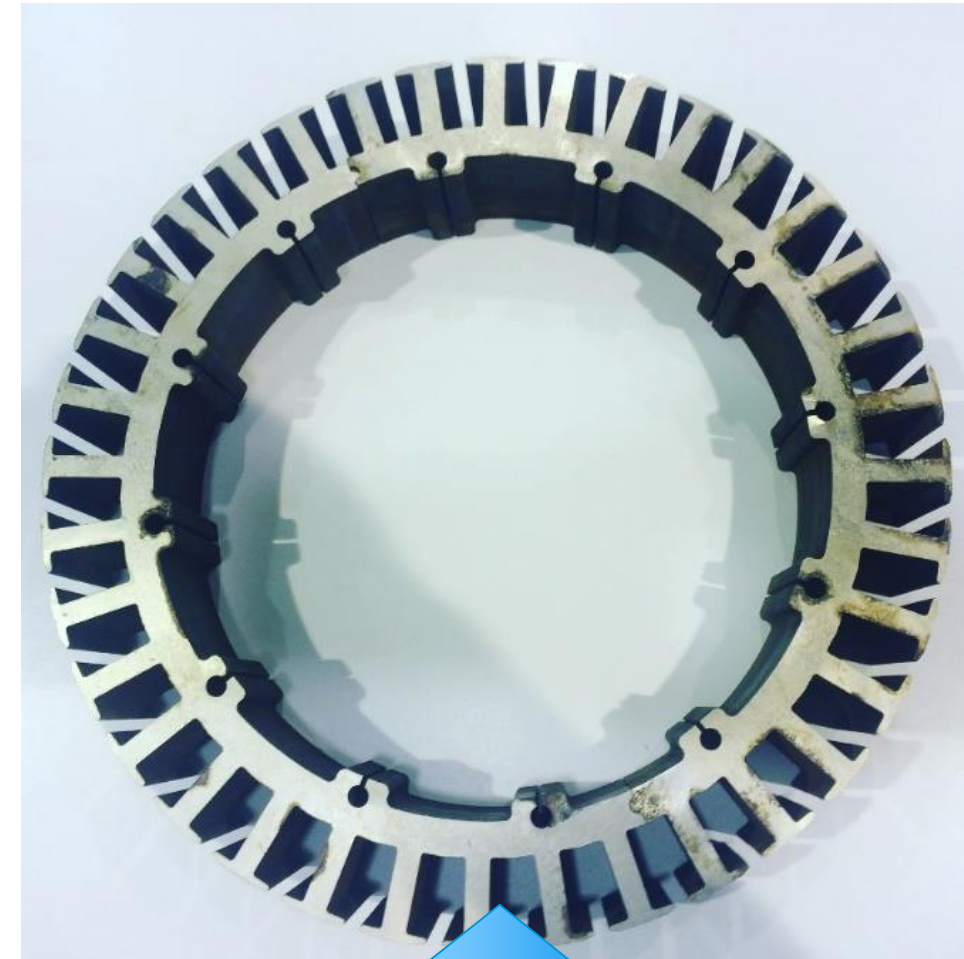
View designs within the browser on any device



Solar Team Directory

Information sharing

Make a motor (Electric team is also Mechanic)



Past design data can also be used via the cloud

Autodesk Fusion 360(教育機関ライセンス)

浜根 洋人

データ 共有メンバー

アップロード 新規フォルダ

デザイン

ソリッド サーフেস シートメタル ツール

作成 修正

足回りeagle動作

Cloud

開く

Rr_足回り Rrモデルデータ

Rrモデルデータの検索

整理 新しいフォルダ

添付ファイル PC 3D オブジェクト

名前 更新日時 種類 サイズ

modelassm	2020/09/19 8:50	ファイル フォルダ	
01_CHASSIS-ADD11.SLDPRT	2020/01/15 14:47	SOLIDWORKS Part...	
01_CHASSIS-FR_20190109_ver2.SLDPRT	2019/05/14 21:57	SOLIDWORKS Part...	4,3
01_CHASSIS-MID1.sldprt	2020/01/15 14:47	SOLIDWORKS Part...	
01_CHASSIS-MID2.sldprt	2020/01/15 14:47	SOLIDWORKS Part...	
01_CHASSIS-RR1.sldprt	2020/01/15 14:47	SOLIDWORKS Part...	
01_CHASSIS-RR2_t 20.3.SLDPRT	2020/01/15 14:47	SOLIDWORKS Part...	
01_chassis-t_190227.SLDASM	2020/01/15 14:47	SOLIDWORKS Ass...	
03_TIRE-ASSY.sldprt	2020/01/12 23:55	SOLIDWORKS Part...	
03_TIRE-ASSY_180910-1.sldprt	2020/01/12 16:13	SOLIDWORKS Part...	
03_TIRE-COVER.sldasm	2020/01/12 16:13	SOLIDWORKS Ass...	
03_TIRE-COVER_IN.sldprt	2020/01/12 16:13	SOLIDWORKS Part...	

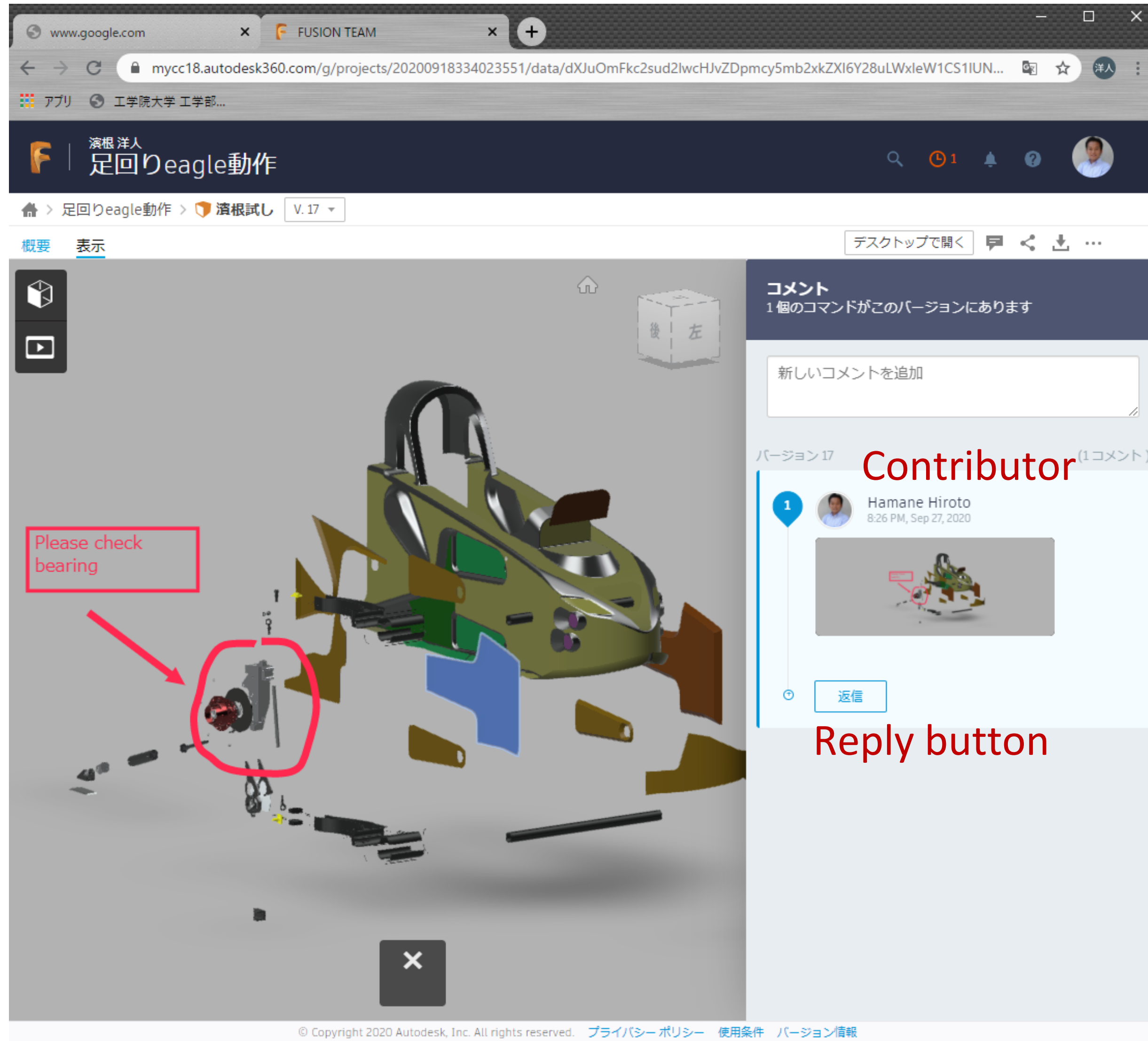
ファイル名(N): SolidWorks ファイル (*.prt;*.asm;*)

開く(O) キャンセル

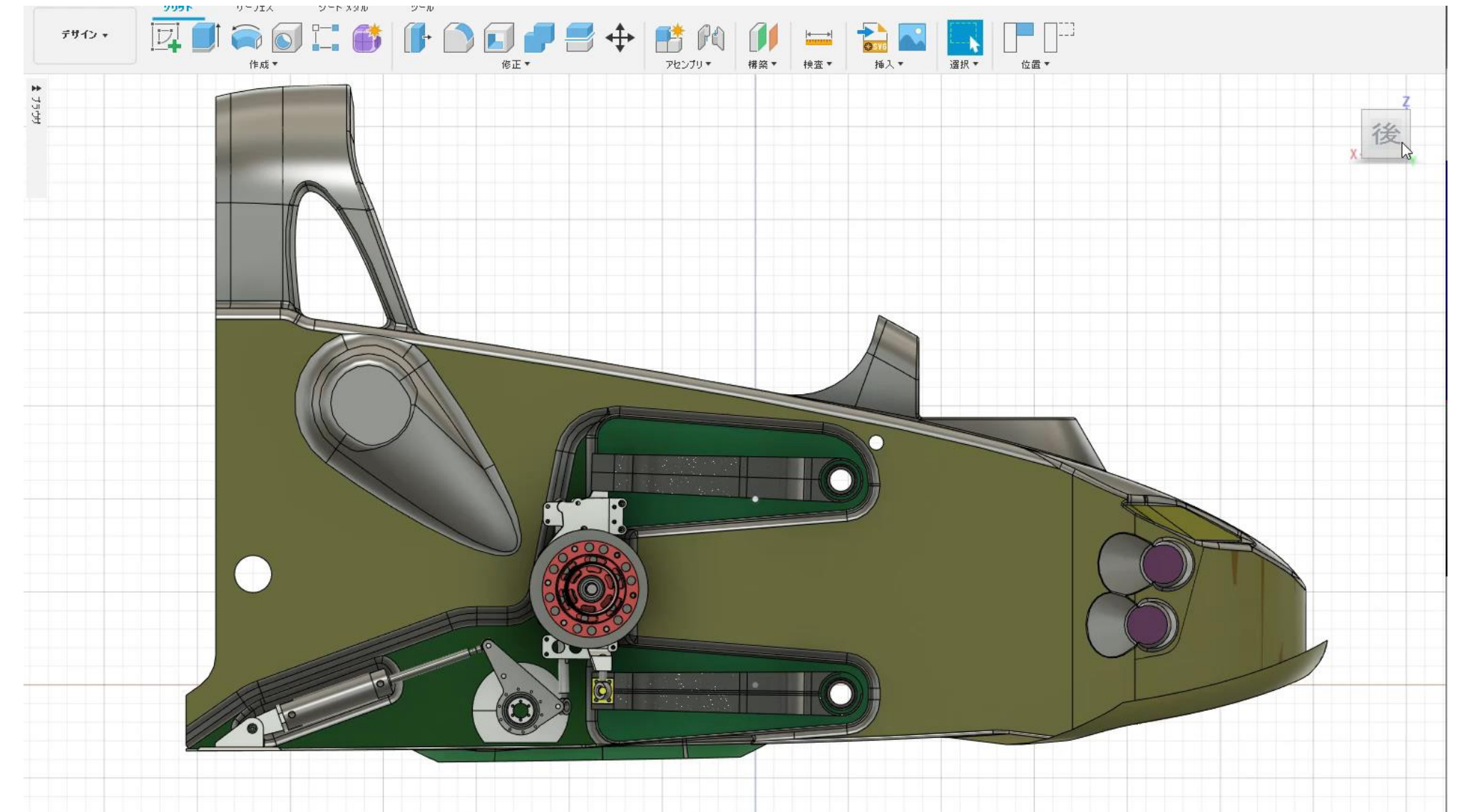
SolidWorks data

Review and comment on designs individually or as a group

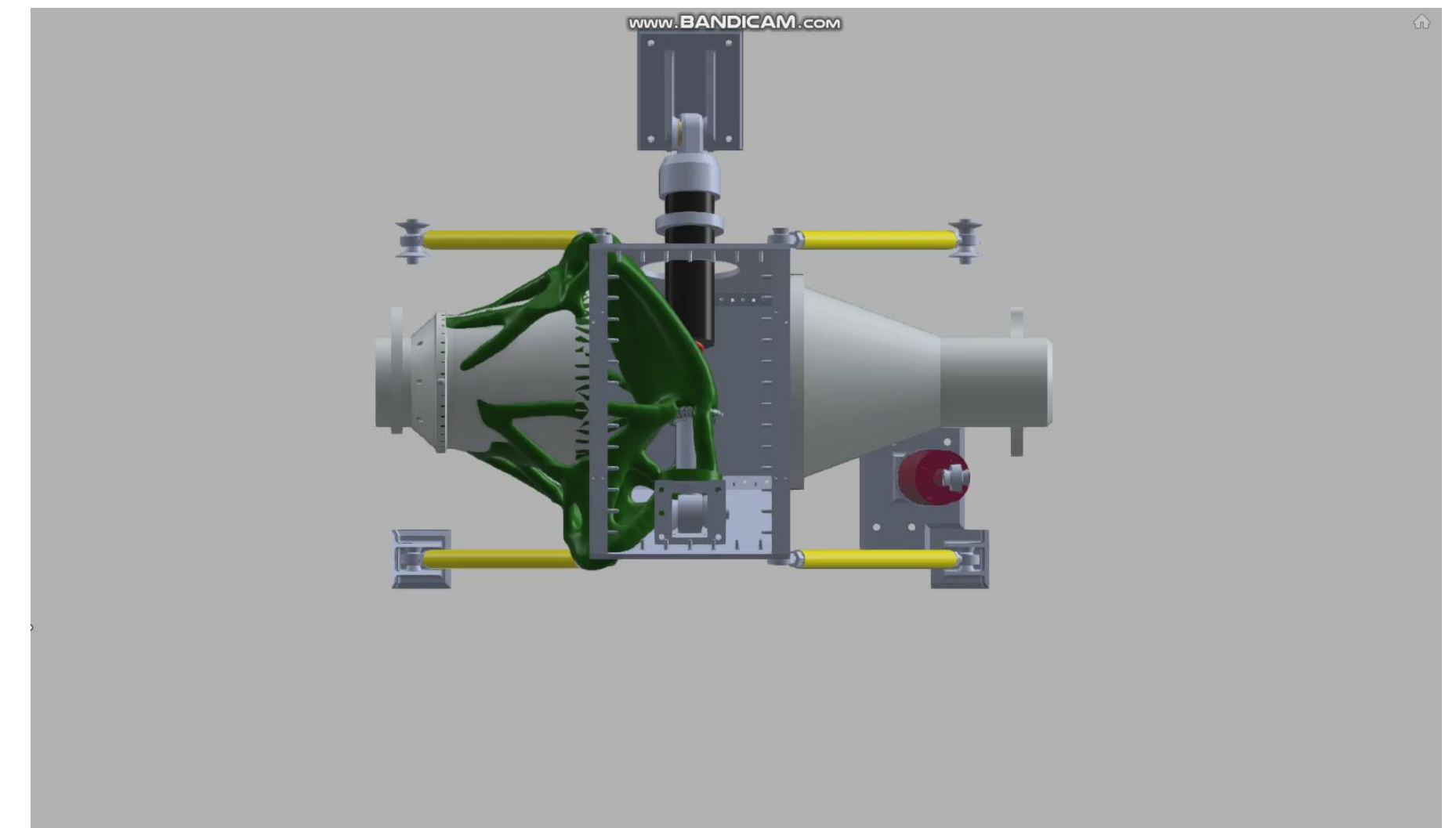
Review and comment to member via Web browser



Check geometry and dynamic behavior

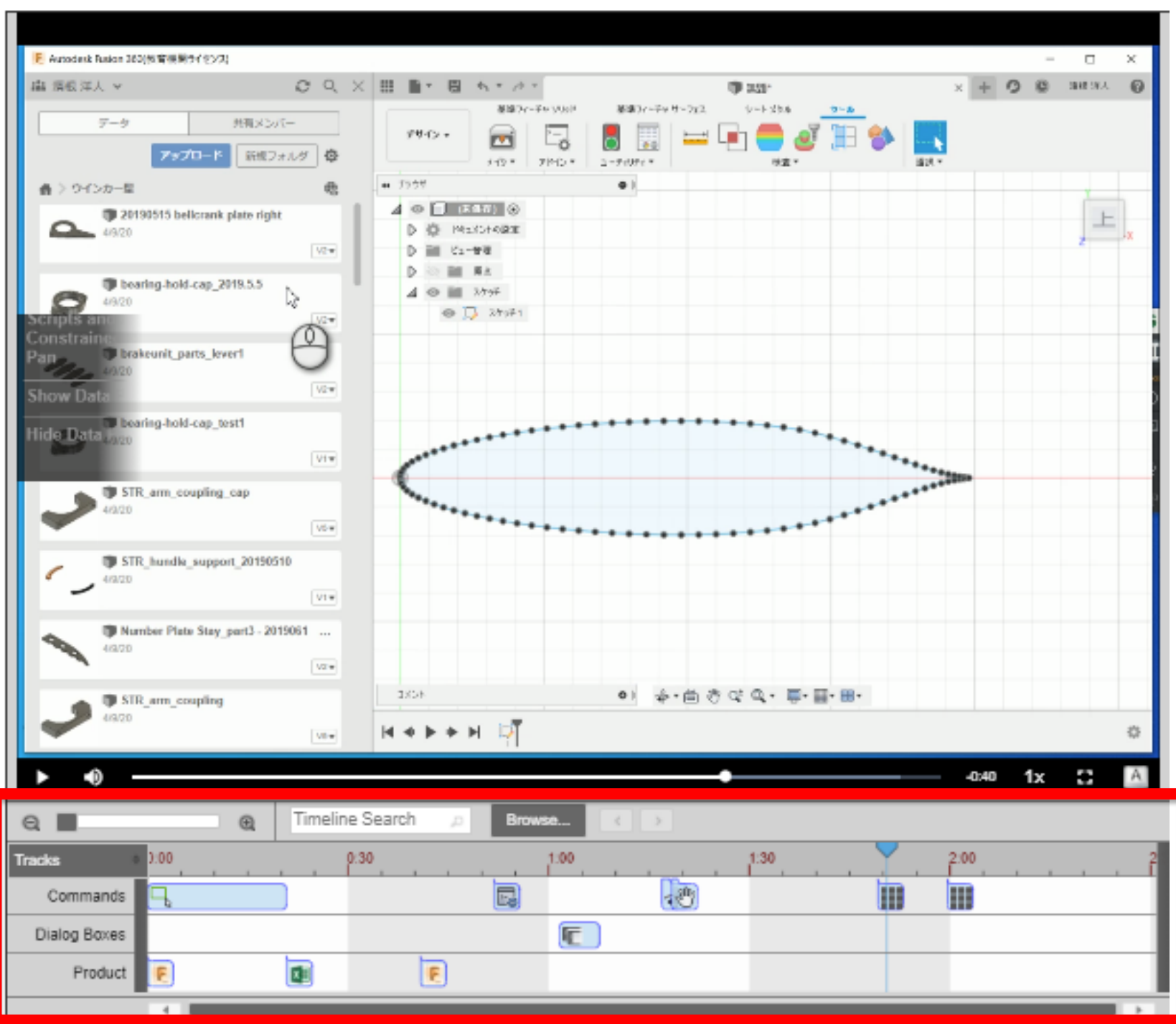
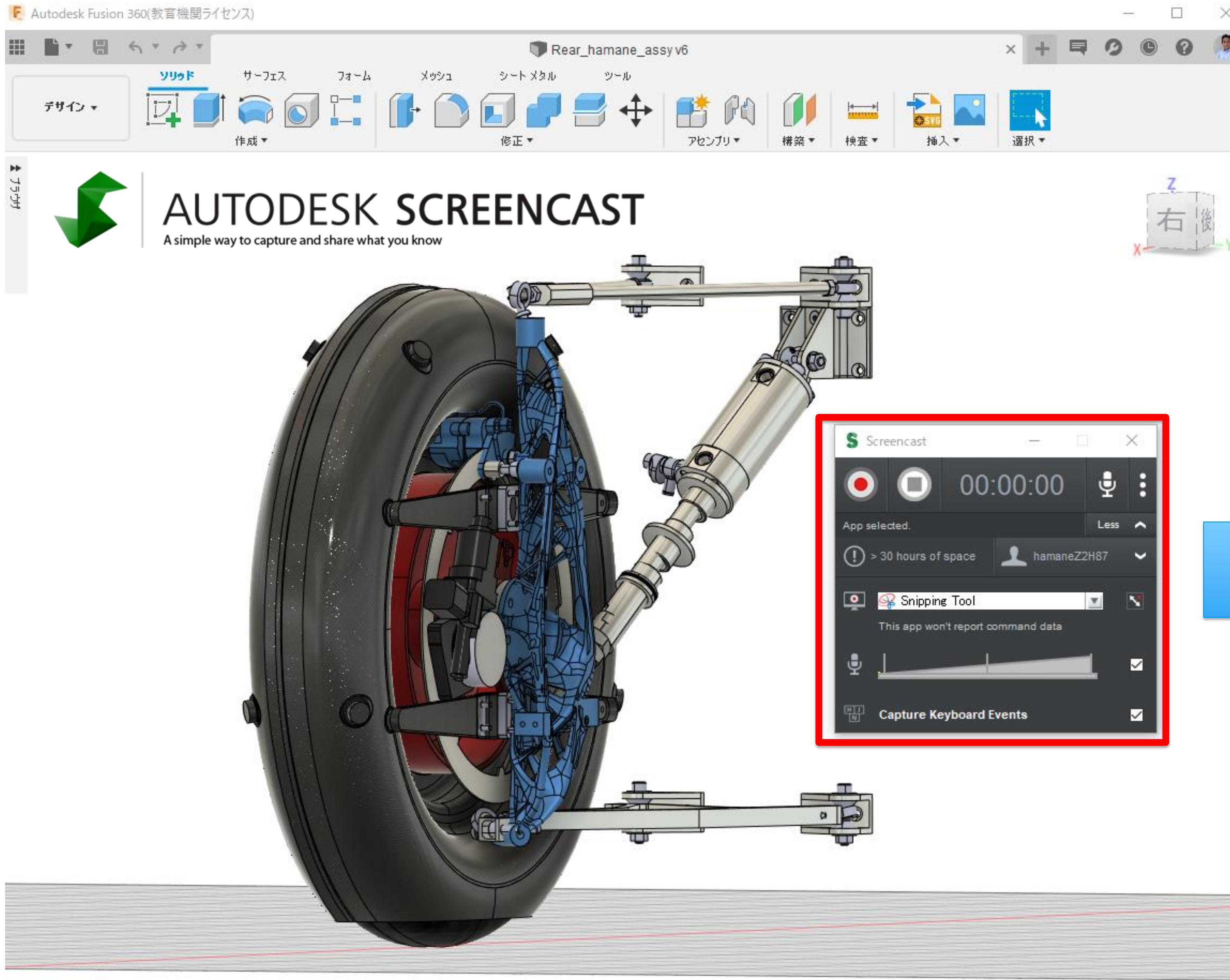


Check “Generative design” assembly



Discussion and teaching on Autodesk Knowledge Website

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



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

Door : one side opening and closing function

- Simple structure
- Lighter

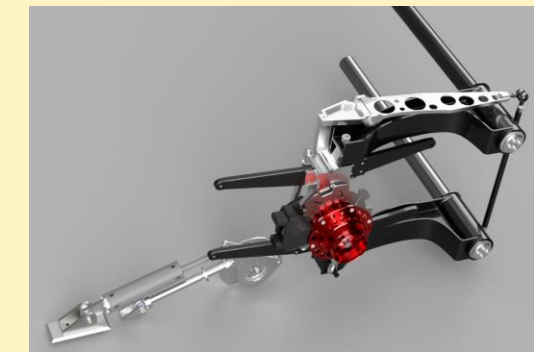
Door : Both sides opening and closing function

- Reduced operation time
- 2 minutes reduction at control points

Aero-fin

- Improvement of air resistance

Tire cover



ADOPT

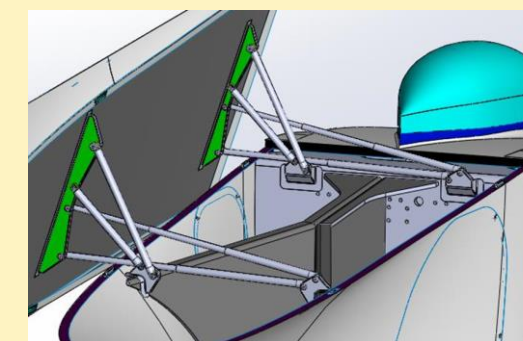
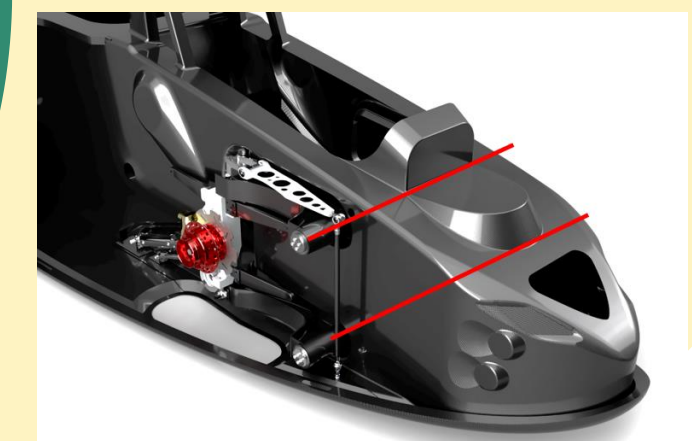
4WS
Yacht running

- The mass will be heavy.(5kg)
- ➡ Reduced consumption (70W)

ADOPT

ADOPT

Weight reduction by standardizing parts.
Change to CFRP parts.
(Solved the weight increase for the new suspension)



ADOPT



ADOPT

Comprehensive judgment

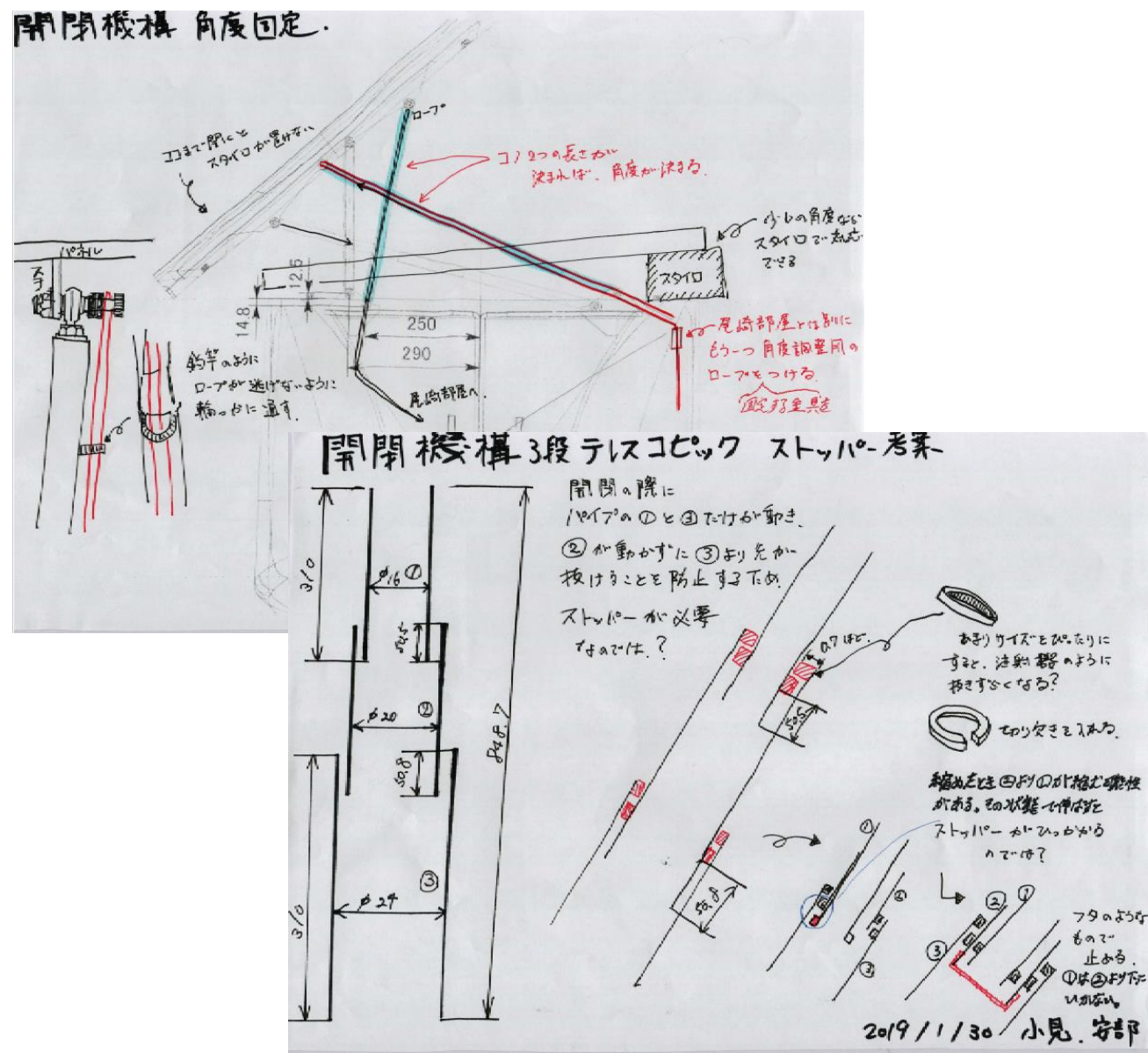
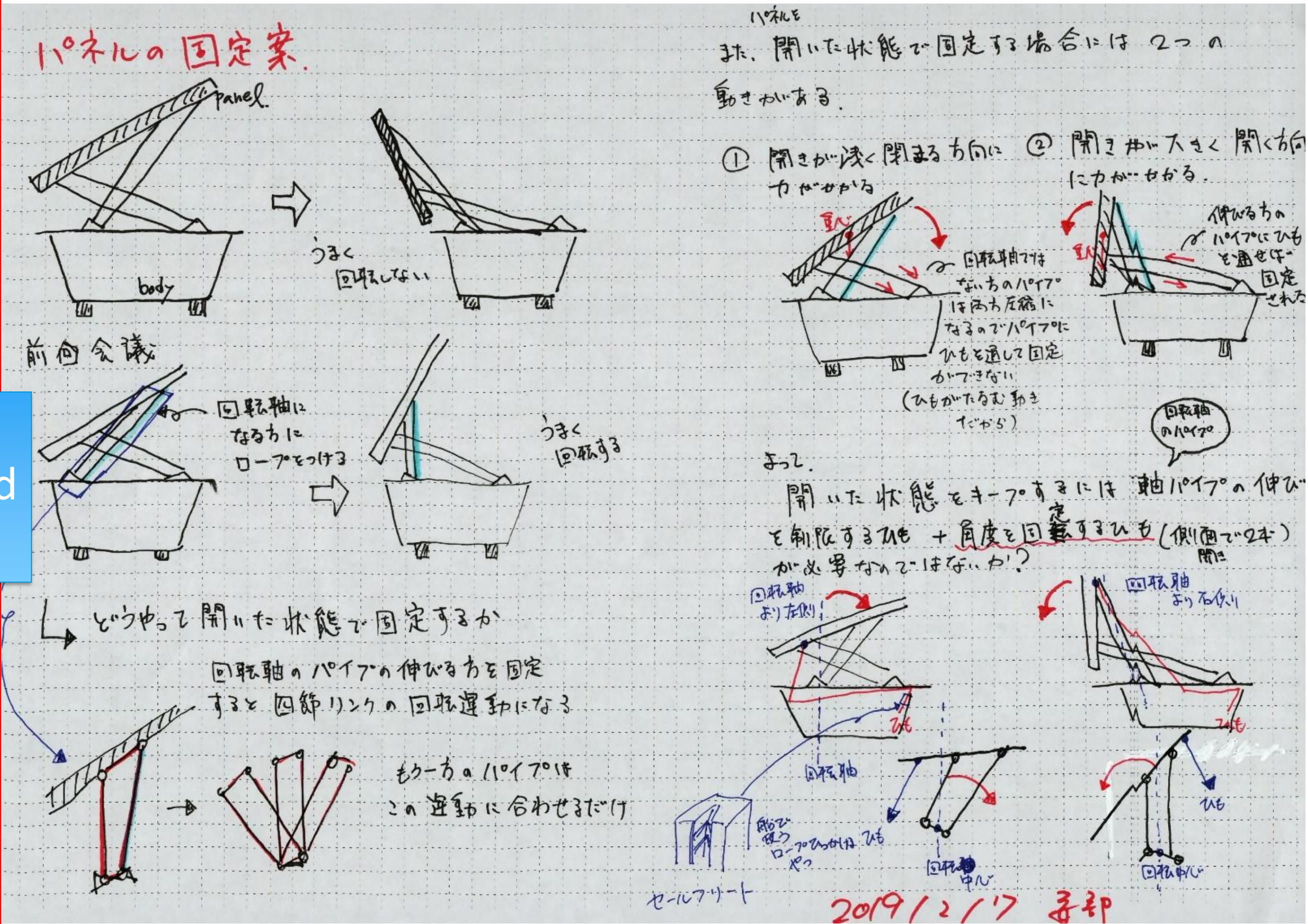
Goal



Total consumption
reduction
approximately 12.5%

Handwriting for new ideas on Fusion 360

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



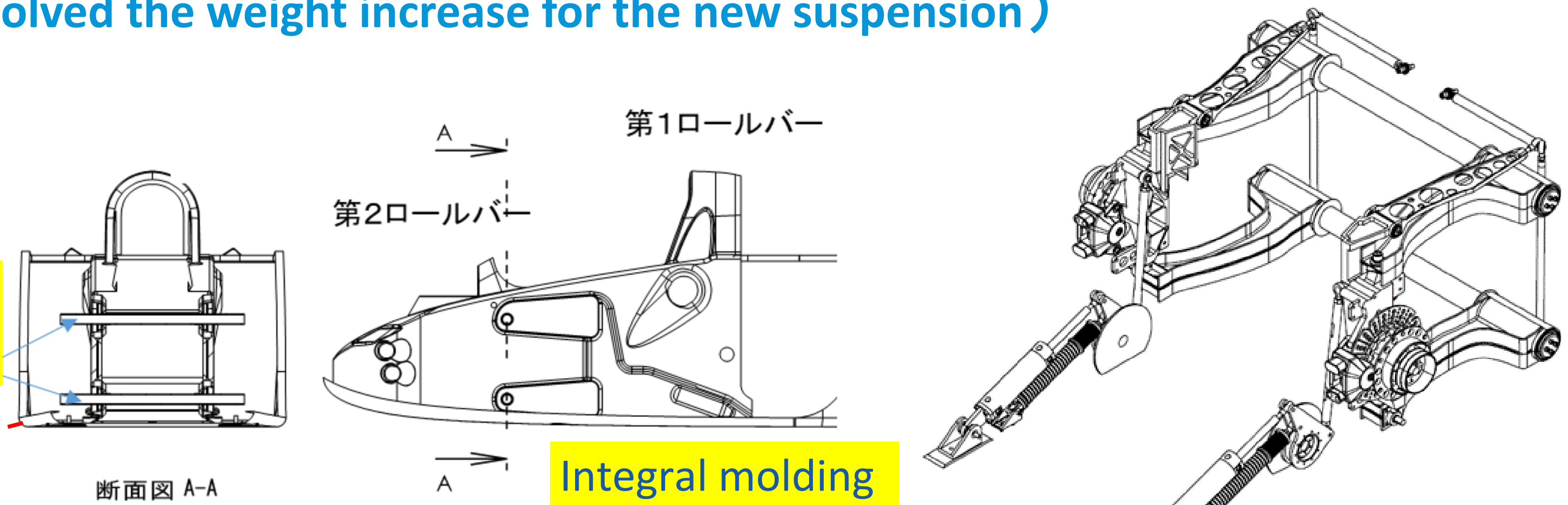
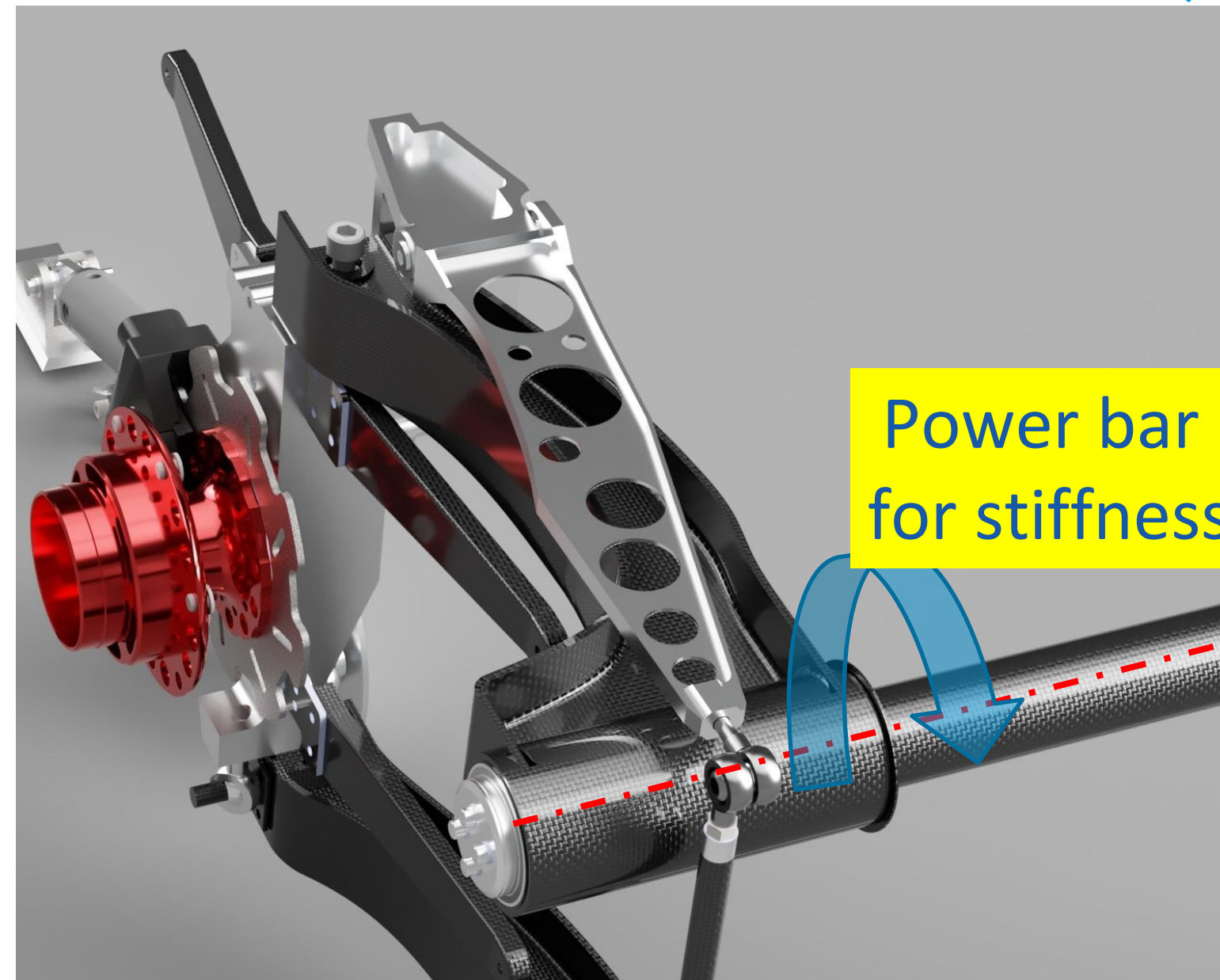
For your information (FYI)

「sentence」→「Manga (draw illustrations)」

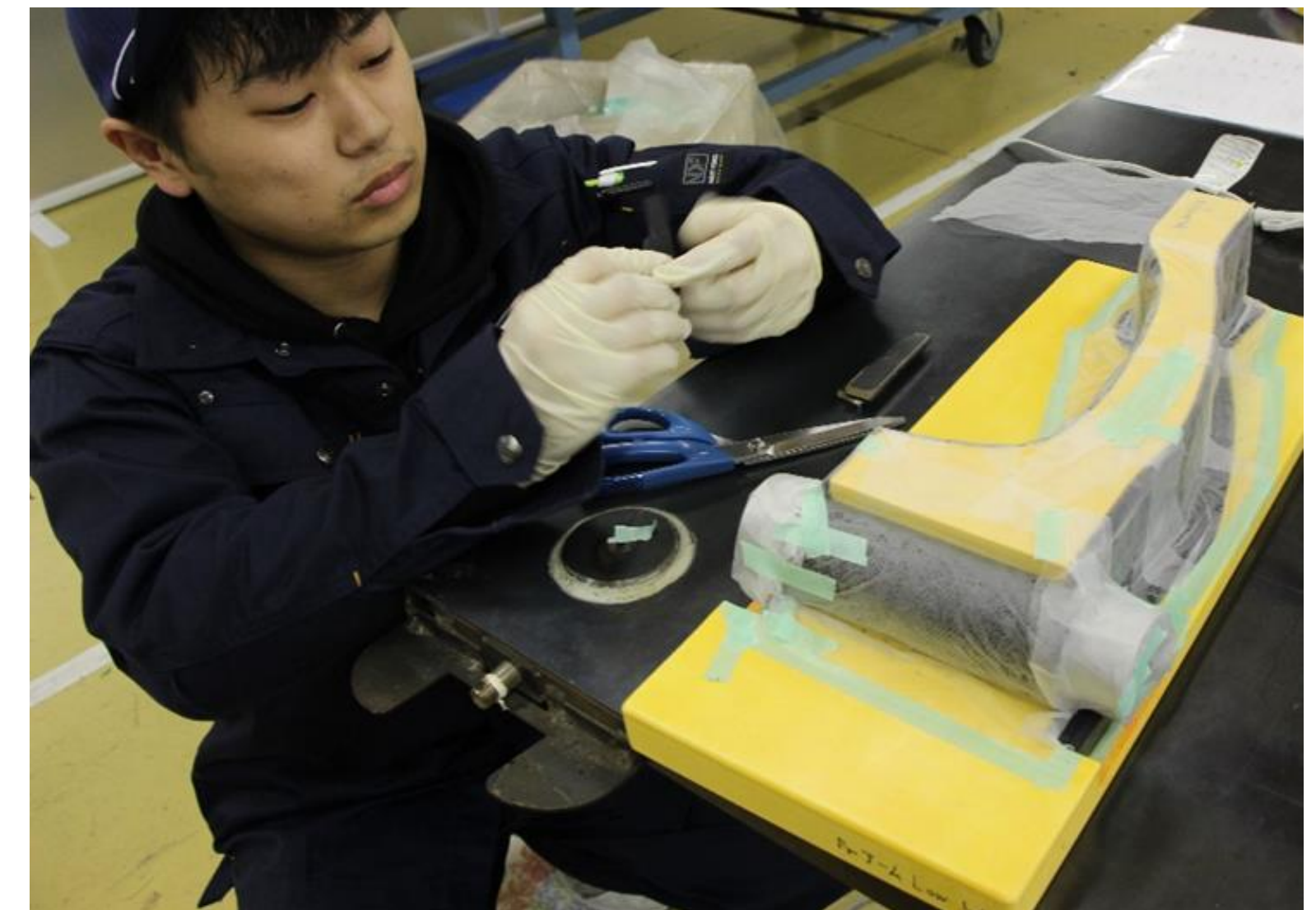
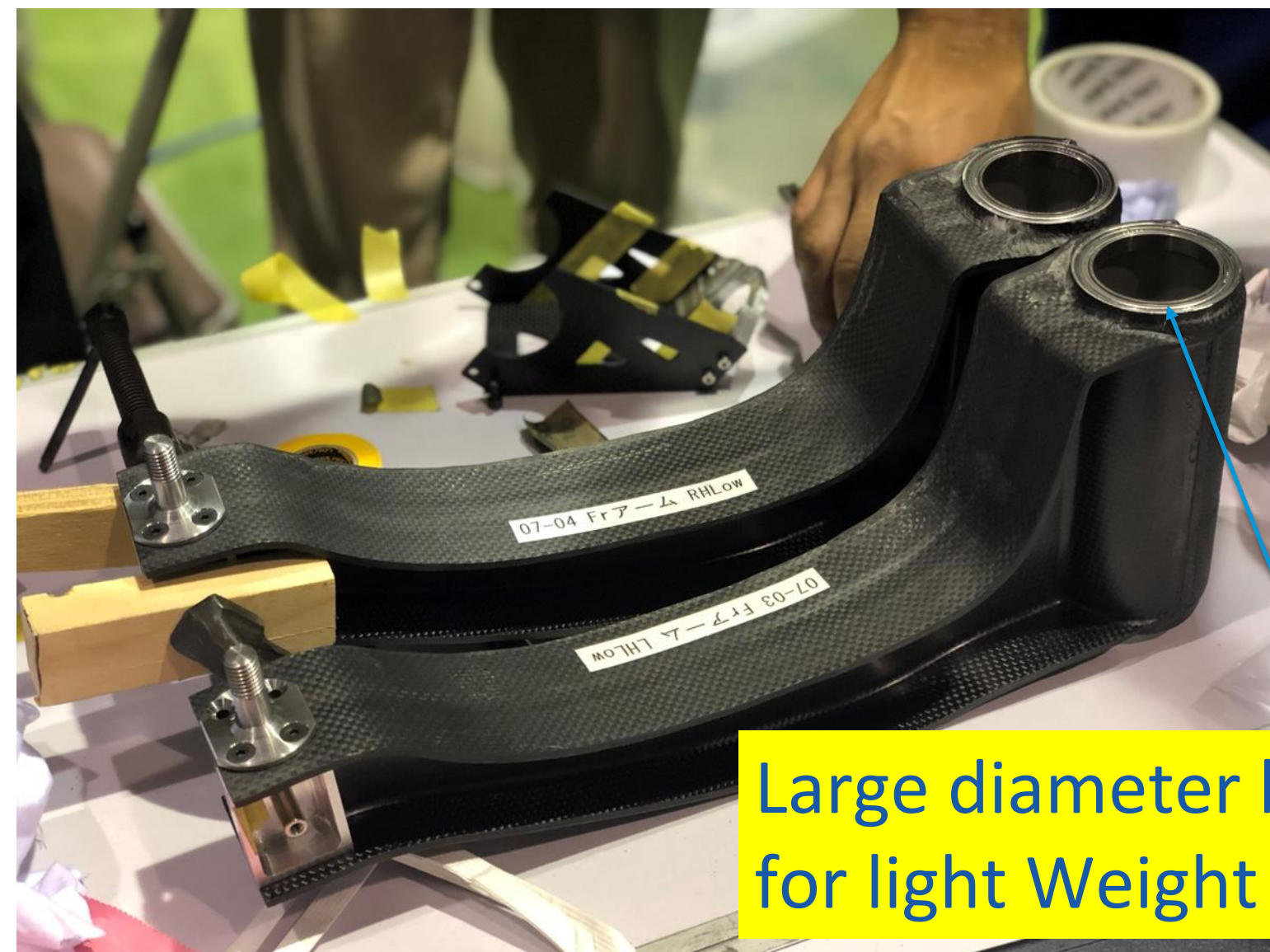


Weight reduction by common parts. Change to CFRP parts.

(Solved the weight increase for the new suspension)



Common swing arm and power bar(pipe)

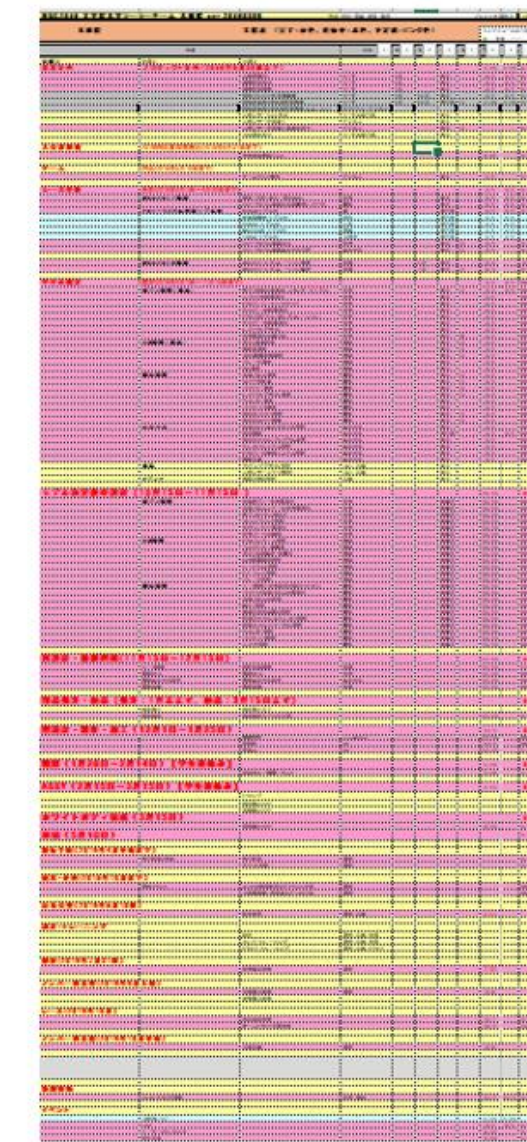


Master schedule (2 years)

Schedules

Intermediate schedule

2 years



WISC2019 工学院大学ソーラーチーム 大日程 ver.20180306									
大日程									
工程表 (完了:灰色、進行中:水色、予定:ピンク色)									
作業	担当	作業日	予定	完了	開始	終了	開始	終了	備考
再設計・最終図面(11月15日~12月15日)	設計・製作	11/15	12/15		11/15	12/15			
部品発注・納品(発注:1月末まで、納品:3月15日まで)	部品発注	11/15	3/15		11/15	3/15			
型設計・製作・加工(12月1日~1月25日)	設計・製作	12/1	1/25		12/1	1/25			
積層(1月28日~2月14日)【学生春休み】	材料加工	1/28	2/14		1/28	2/14			
ASSY(2月15日~3月15日)【学生春休み】	組立	2/15	3/15		2/15	3/15			
ホワイトボディ完成(3月15日)	組立	3/15			3/15				
車空(5月10日)	組立	5/10			5/10				
旅行手配(2019年4月中旬まで)	旅行手配	4/15			4/15				
運営・企画(2018年10月まで)	運営・企画	10/31			10/31				
記者会見(2019年6月10日)	記者会見	6/10			6/10				
試走・トレーニング	試走・トレーニング								
船便(2019年7月31日)	船便	7/31			7/31				

WISC2019 ソーラーチーム大日程									
open and close mechanism									
3Dモデル	名称/部数	注記	進捗状況	加工終了予定日	3/14	3/15	3/16	3/17	3/18
ロッド	ロッド (φ24-350, φ24-450mm φ18-20mm, φ18-20mm)		部材到着						
	ダンデンボルトカバー		部材発注済み						
	ダンデンブッシュ (φ16, φ20)		部材発注済み						
	スプーラー(φ20, φ24)		部材発注済み						
	スプーラー		部材発注済み						
	スプーラーlong#1	PVスプーラー#1(φ20)のスプーラー	部材発注済み						
	スプーラーlong#2	PVスプーラー#2(φ25)のスプーラー	部材発注済み						
	ボディーブッシュ		部材発注済み						
	PVブッシュ		部材発注済み						
	中継ダンデン用ブッシュ		部材発注済み						



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	カムシャフト		完了		CNC					
2	ペダルバネ		完了		上原	2019/5/17		2019/5/31		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			2019/5/15		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

Progress management table for each group

Progress of each member can be checked at WEB SITE.

詳細

アクティビティ

20200813 plate



雄大 早川 アップロード
されました
9月-18-2020

等速ボールジョイント



会社 アップロード
されました
9月-17-2020

Eagle_20200916_MATSUDA



直大 松田 更新されまし
た
9月-16-2020

塩ビ管寸法検討_MATSUDA_20200915



直大 松田 アップロード
されました
9月-15-2020

塩ビ君_ASSY_MATSUDA_20200915



直大 松田 更新されまし
た
9月-15-2020



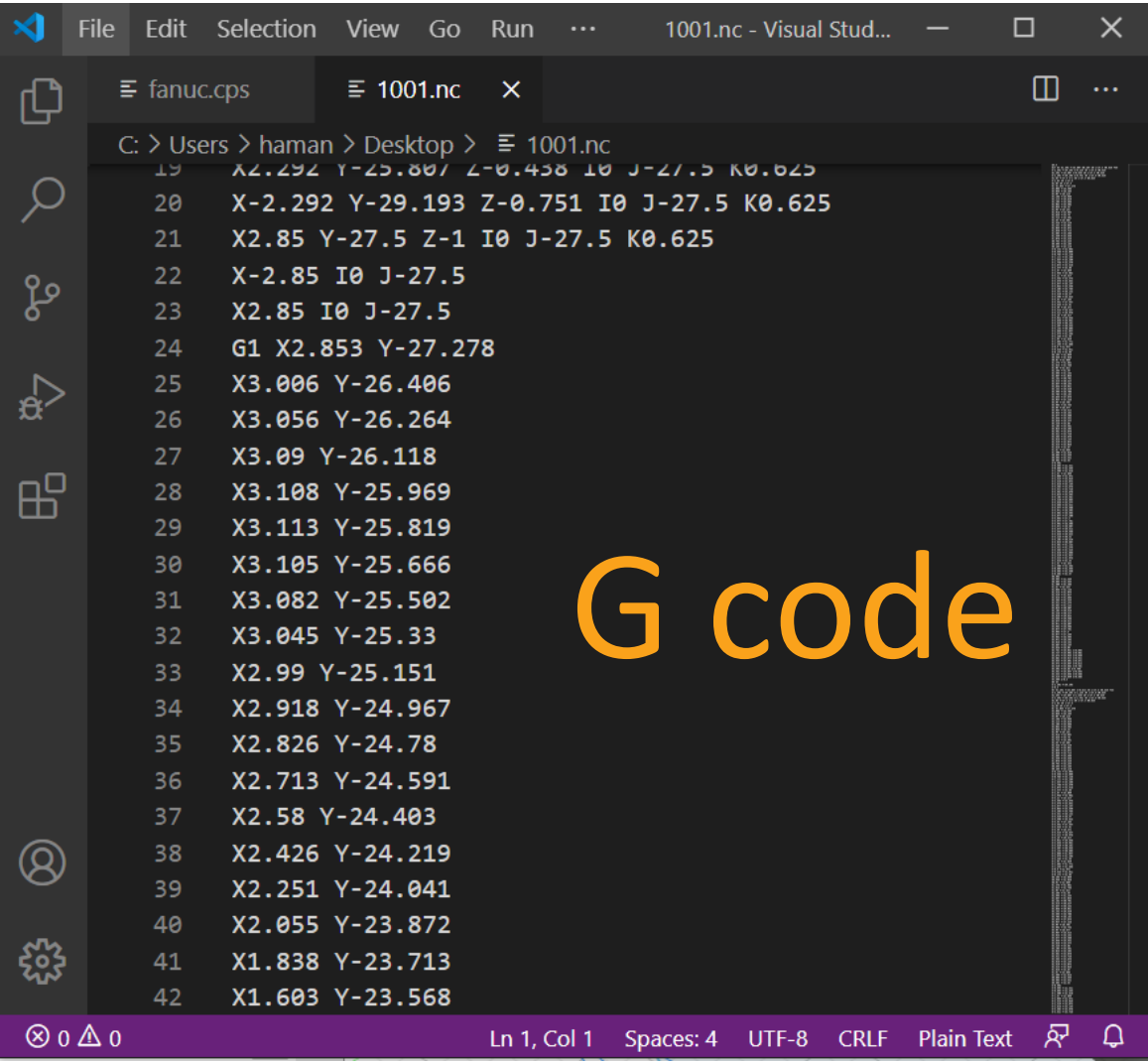
Team Progress Table

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_LR 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-K10-65-10
	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-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



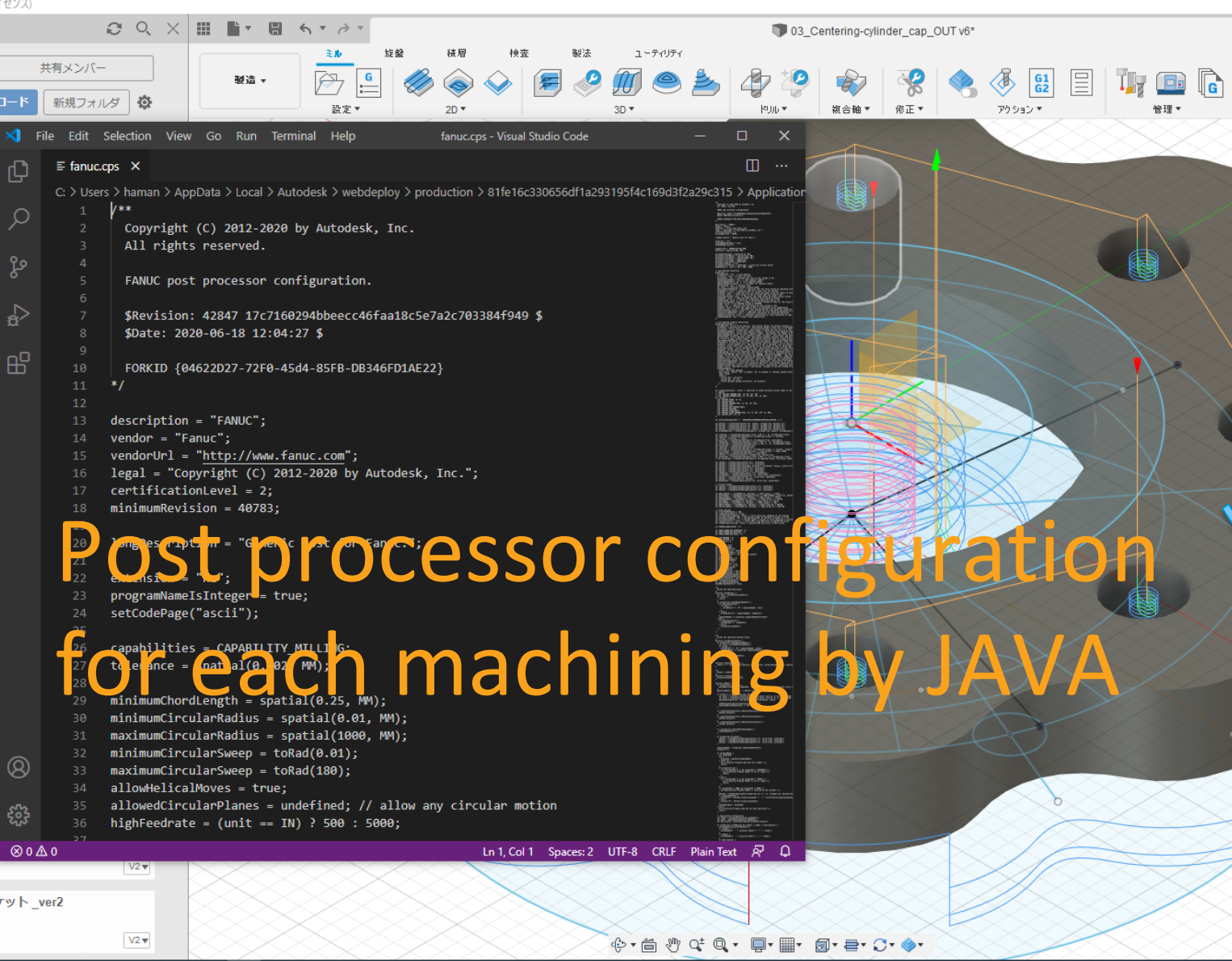
Each Machining Control by the Cloud of Fusion 360 CAM

Technical Support Center



```
19 X2.292 Y-25.807 Z-0.458 I0 J-27.5 K0.625
20 X-2.292 Y-29.193 Z-0.751 I0 J-27.5 K0.625
21 X2.85 Y-27.5 Z-1 I0 J-27.5 K0.625
22 X-2.85 I0 J-27.5
23 X2.85 I0 J-27.5
24 G1 X2.853 Y-27.278
25 X3.006 Y-26.406
26 X3.056 Y-26.264
27 X3.09 Y-26.118
28 X3.108 Y-25.969
29 X3.113 Y-25.819
30 X3.105 Y-25.666
31 X3.082 Y-25.502
32 X3.045 Y-25.33
33 X2.99 Y-25.151
34 X2.918 Y-24.967
35 X2.826 Y-24.78
36 X2.713 Y-24.591
37 X2.58 Y-24.403
38 X2.426 Y-24.219
39 X2.251 Y-24.041
40 X2.055 Y-23.872
41 X1.838 Y-23.713
42 X1.603 Y-23.568
```

G code



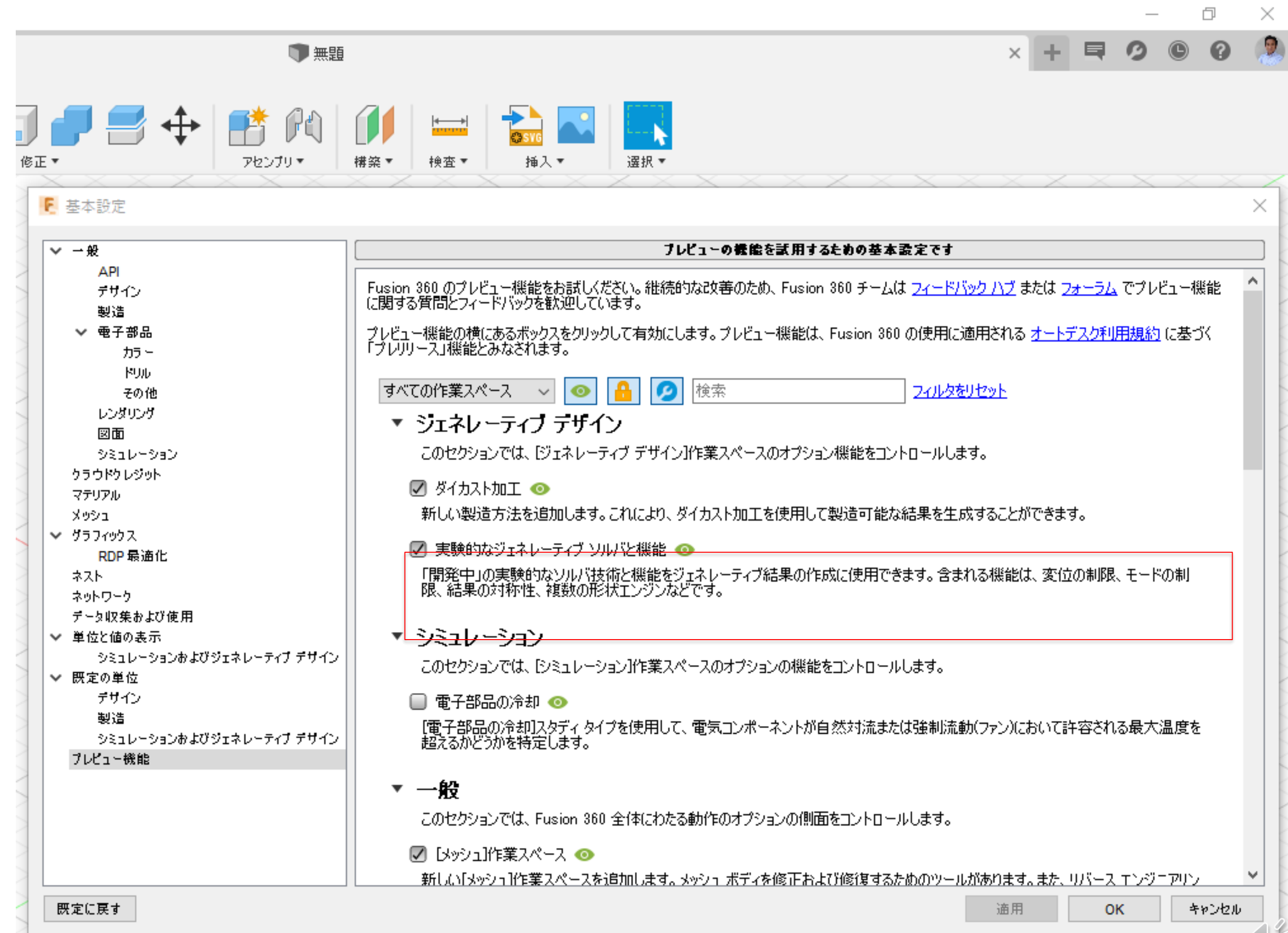
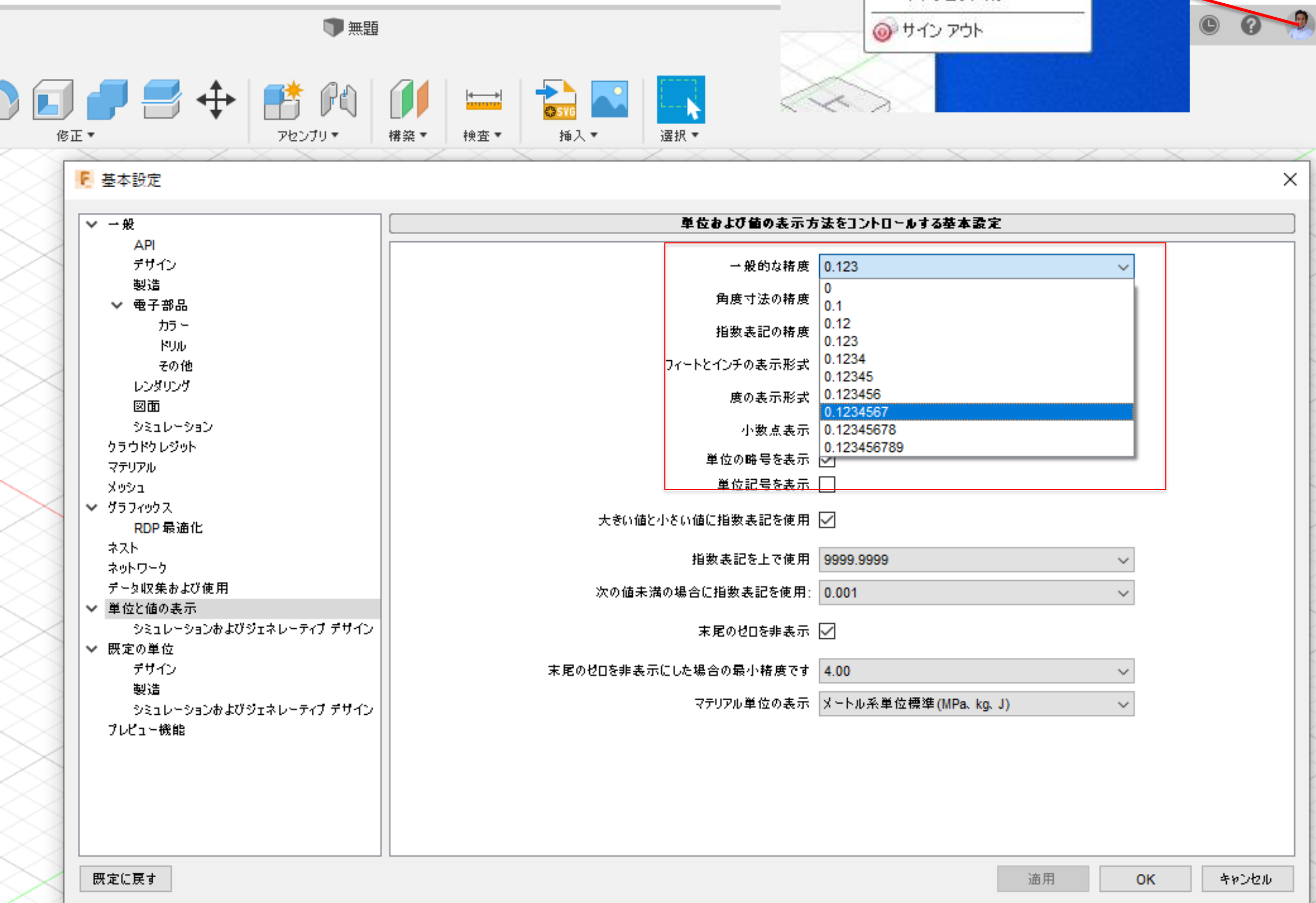
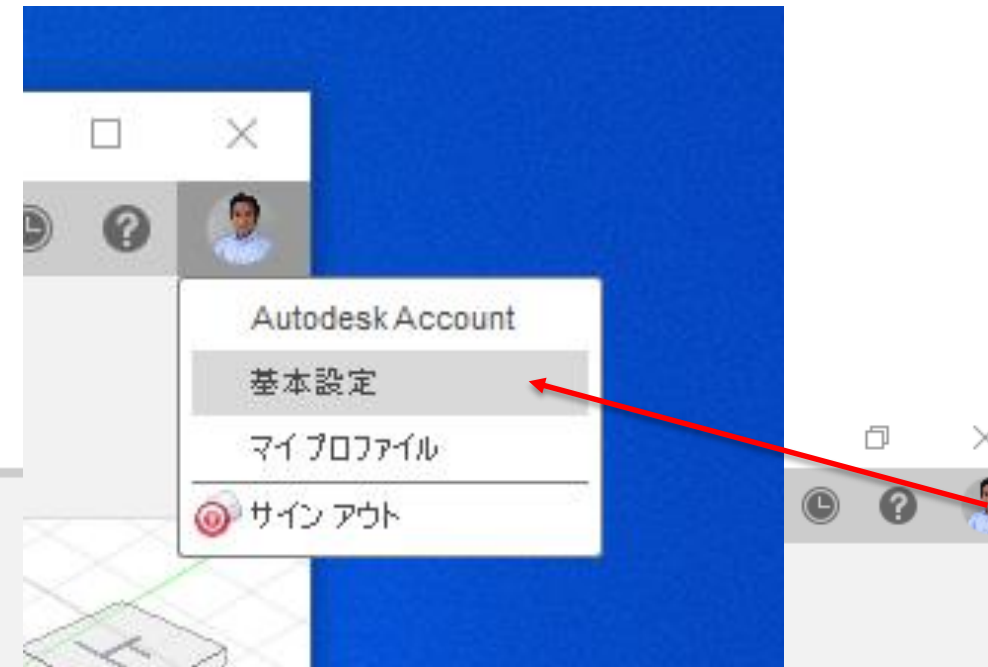
```
1 ***
2 Copyright (C) 2012-2020 by Autodesk, Inc.
3 All rights reserved.
4
5 FANUC post processor configuration.
6
7 $Revision: 42847 17c7160294bbecc46faa18c5e7a2c703384f949 $
8 $Date: 2020-06-18 12:04:27 $
9
10 FORKID {04622027-72F0-45d4-85F8-DB346FD1AE22}
11
12
13 description = "FANUC";
14 vendor = "Fanuc";
15 vendorUrl = "http://www.fanuc.com";
16 legal = "Copyright (C) 2012-2020 by Autodesk, Inc.";
17 certificationLevel = 2;
18 minimumRevision = 40703;
19
20 capabilities = CAPABILITY_MILLING;
21 tolerance = 0.001;
22
23 minimumChordLength = spatial(0.25, MM);
24 minimumCircularRadius = spatial(0.01, MM);
25 maximumCircularRadius = spatial(1000, MM);
26 minimumCircularSweep = toRad(0.01);
27 maximumCircularSweep = toRad(180);
28 allowHelicalMoves = true;
29 allowedCircularPlanes = undefined; // allow any circular motion
30 highFeedrate = (unit == IN) ? 500 : 5000;
```

Post processor configuration for each machining by JAVA



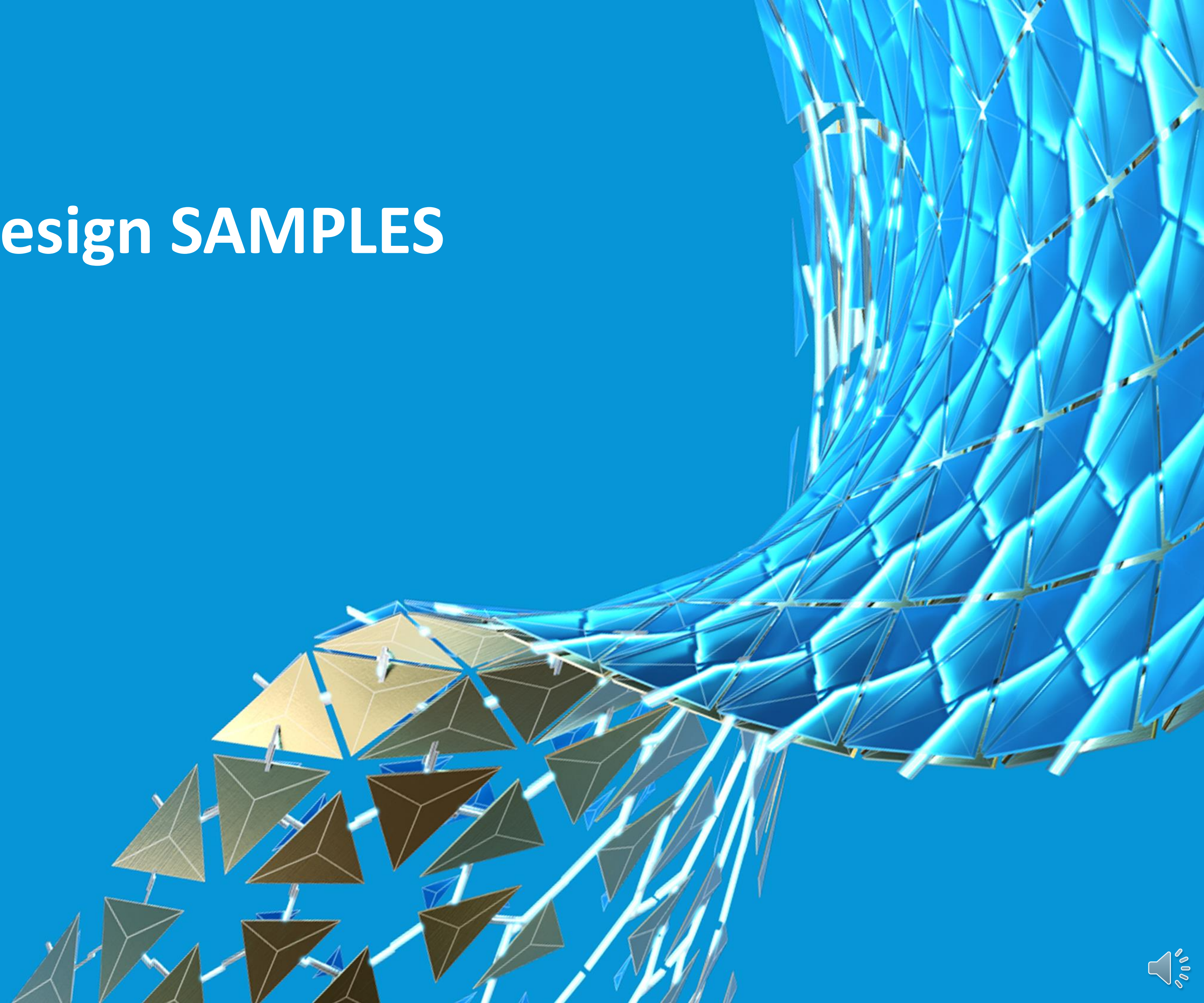
You can find the settings button by clicking on your photo.

Make sure everyone on the team has the same settings.

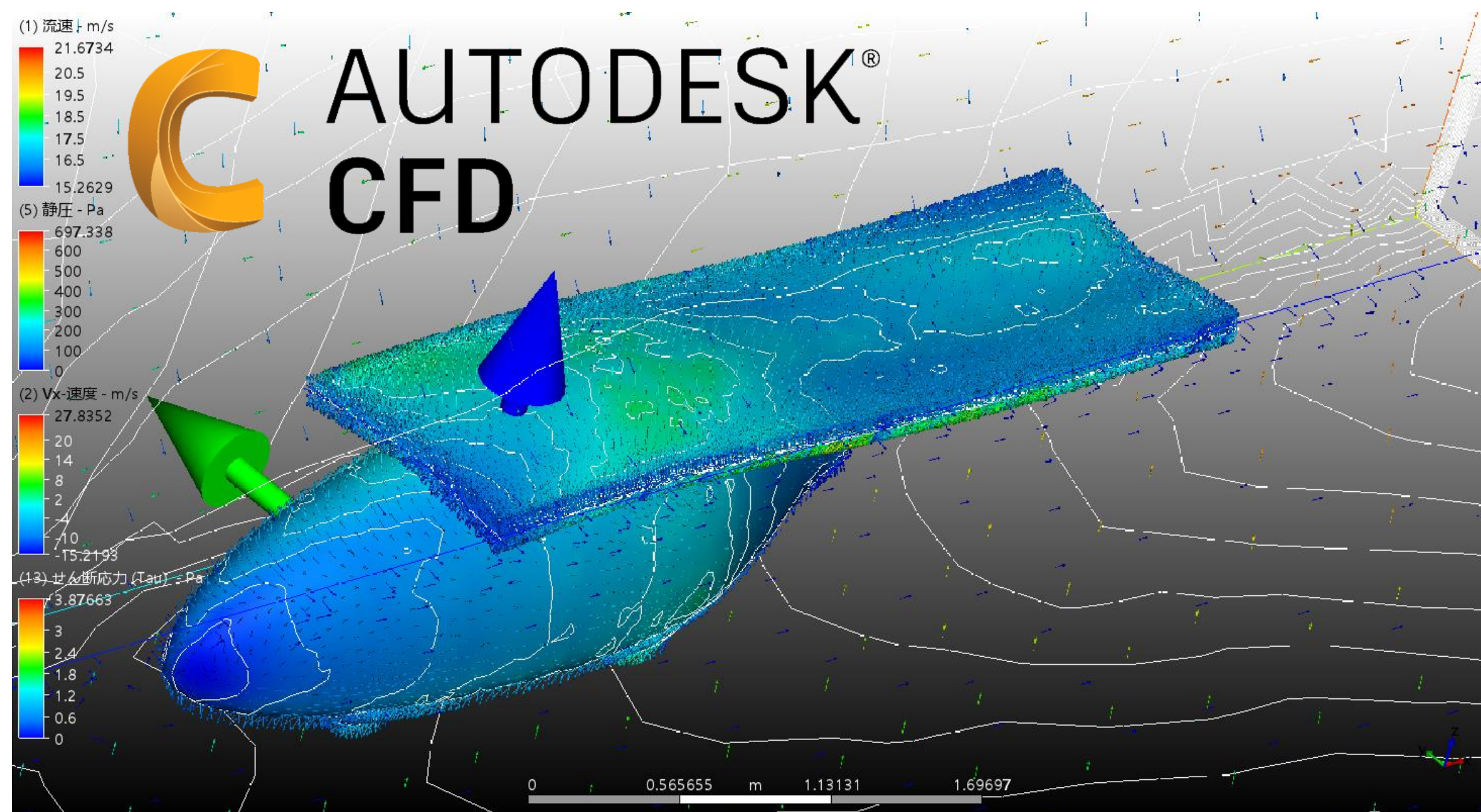
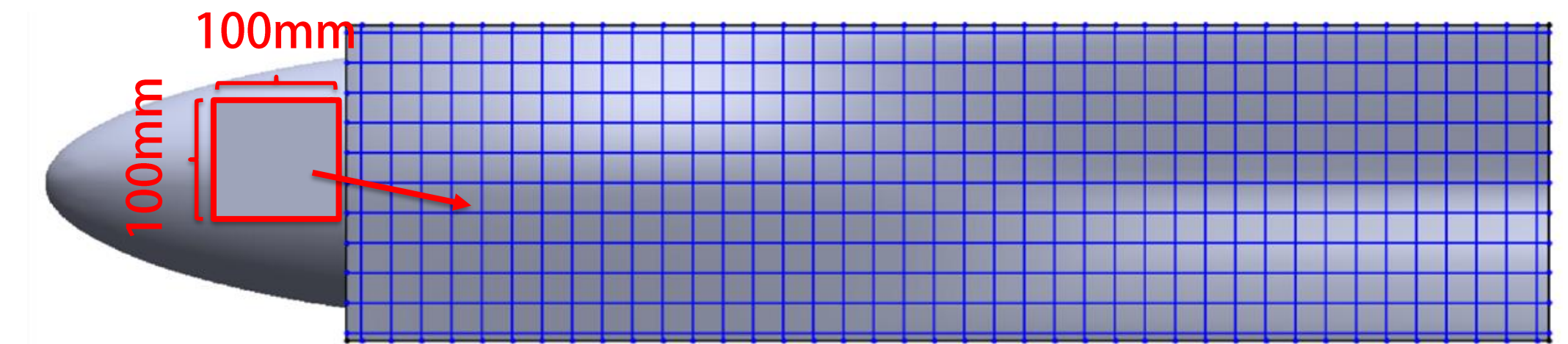


Solar Vehicle Design SAMPLES

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

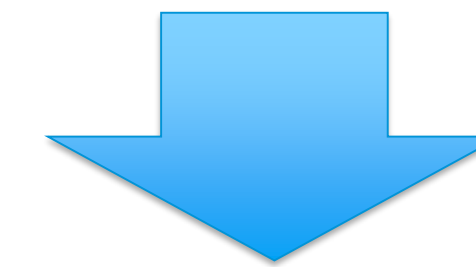


How to estimate the load on the wing ?

[illegible]

The forces applied to each area were added.

The entire wing receives a force of 240.72N

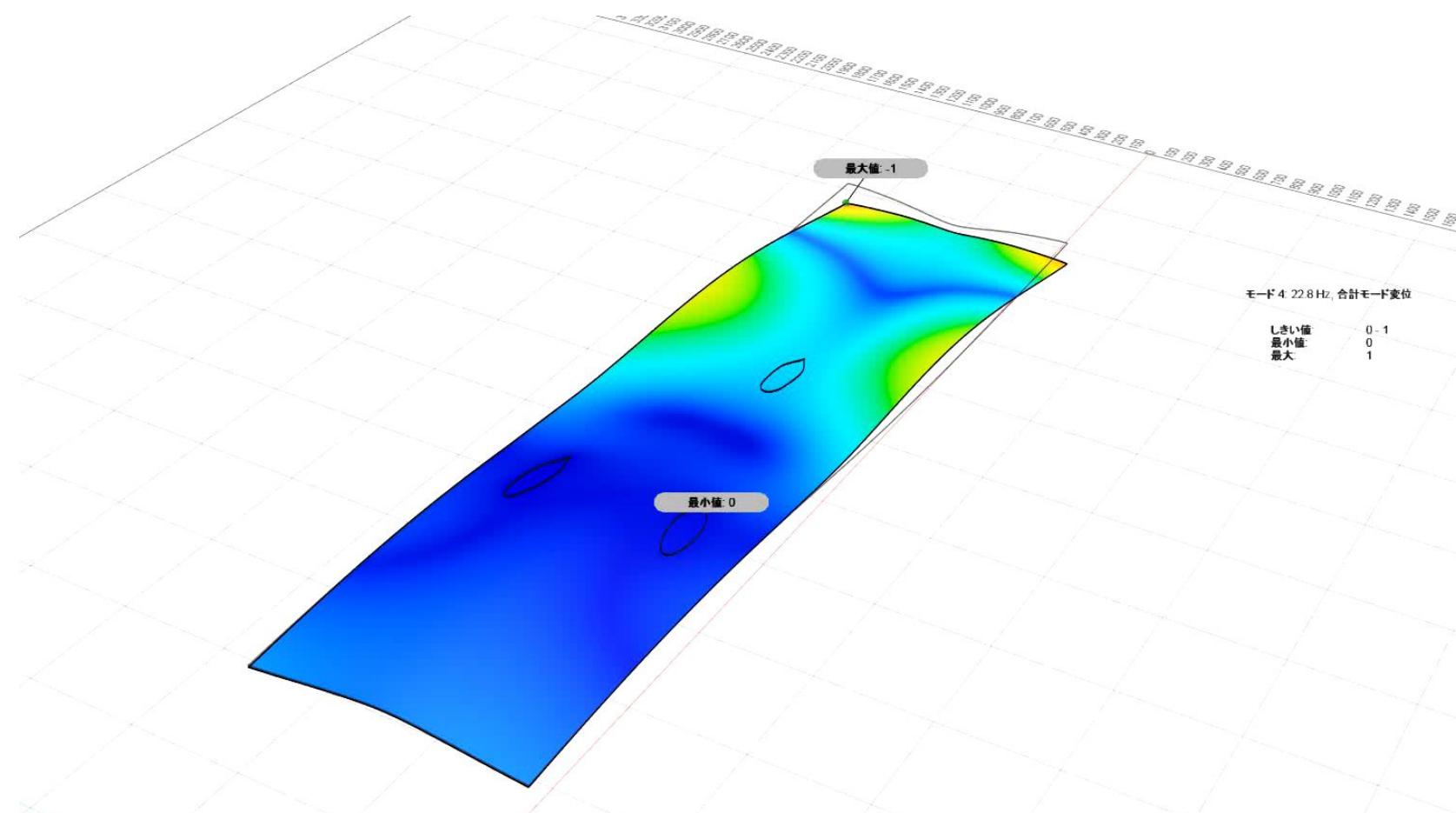


Optimize the placement of UD (CFRP high pitch material)

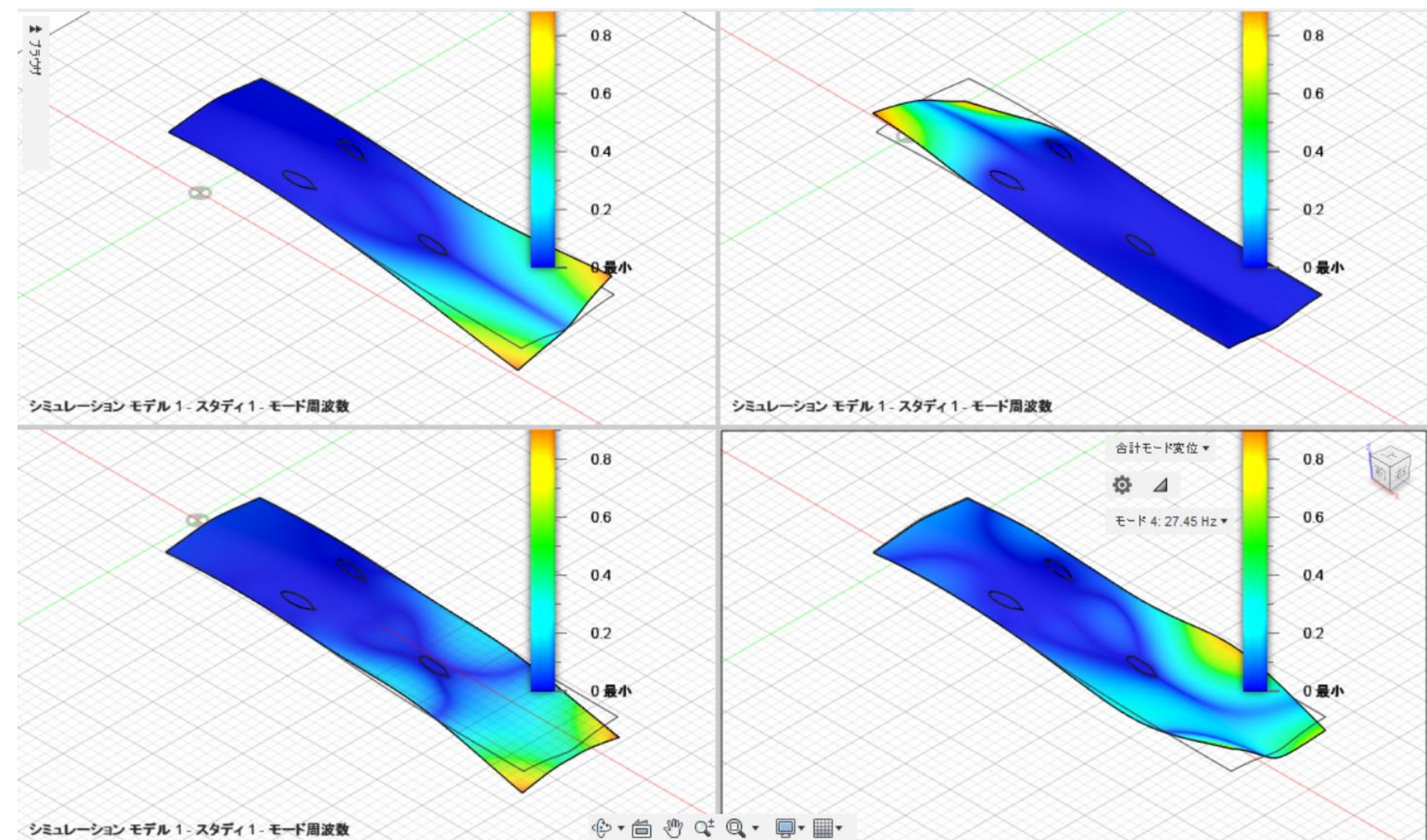


Flutter phenomenon (Wing will be destroyed?)

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


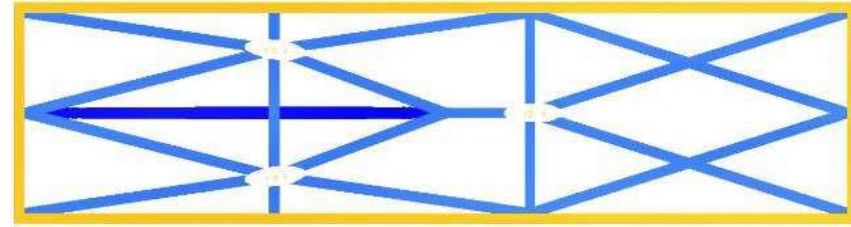
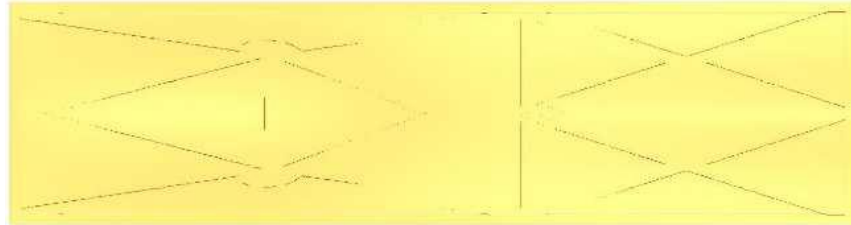





Optimize the placement of UD (CFRP high pitch material)

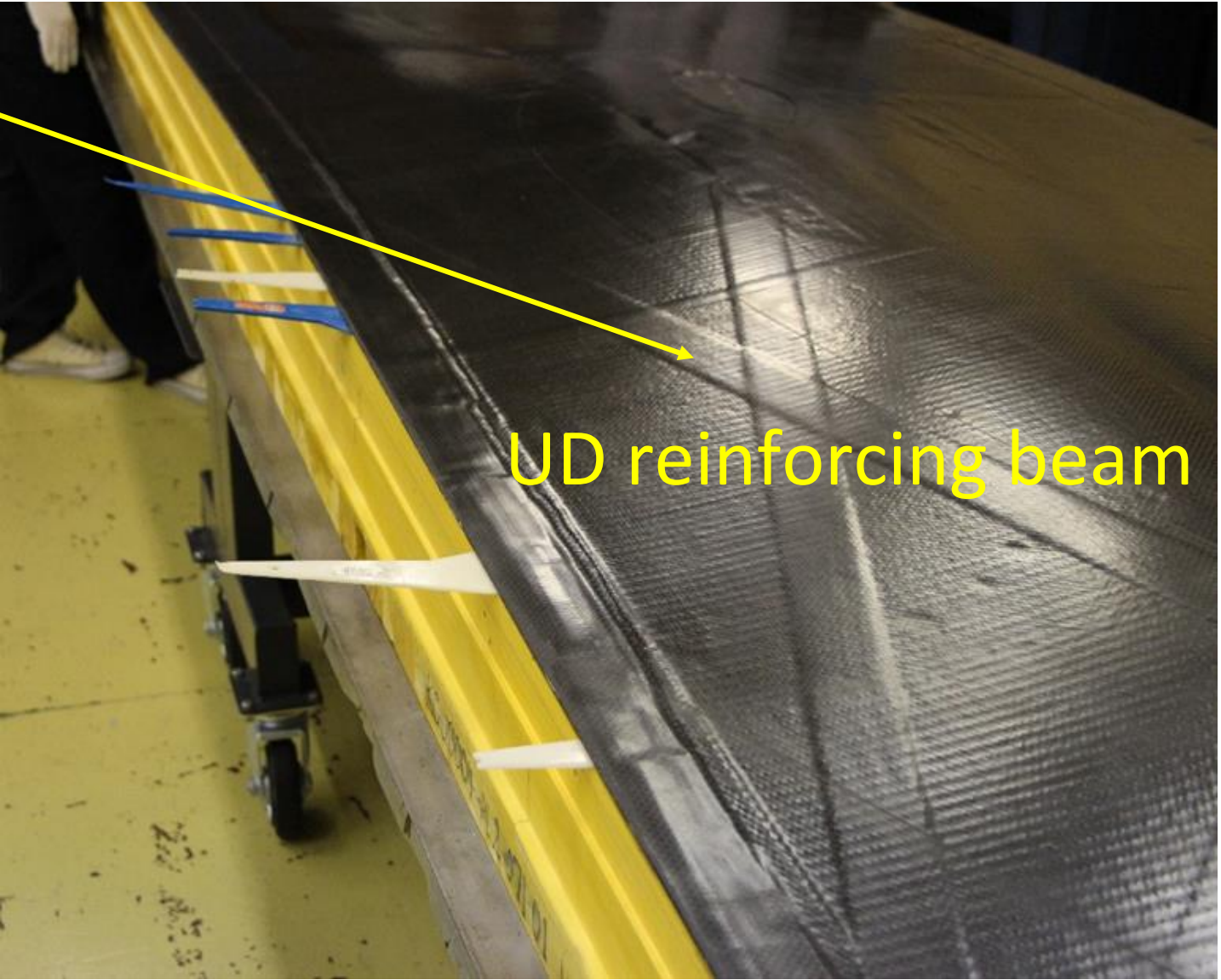
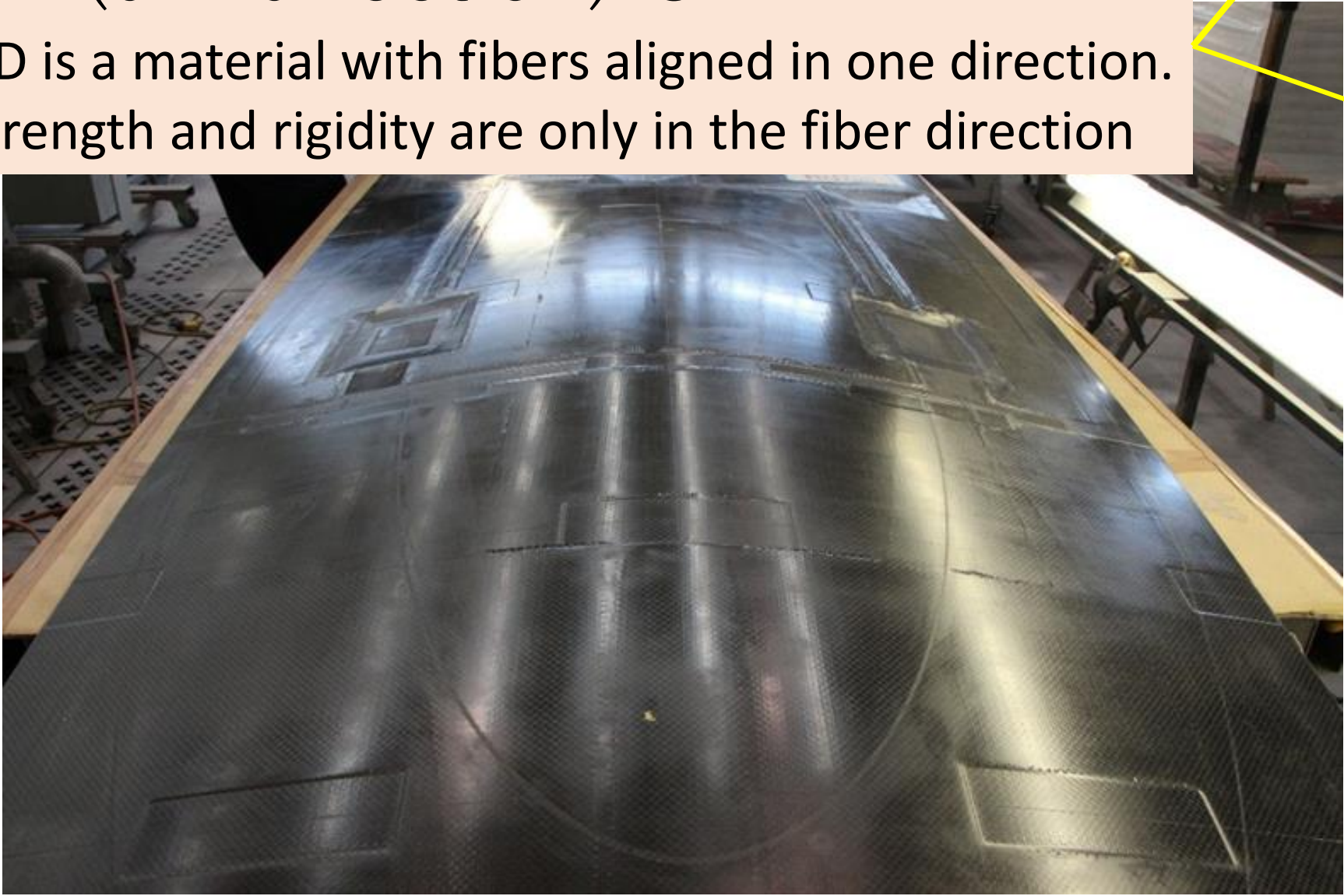
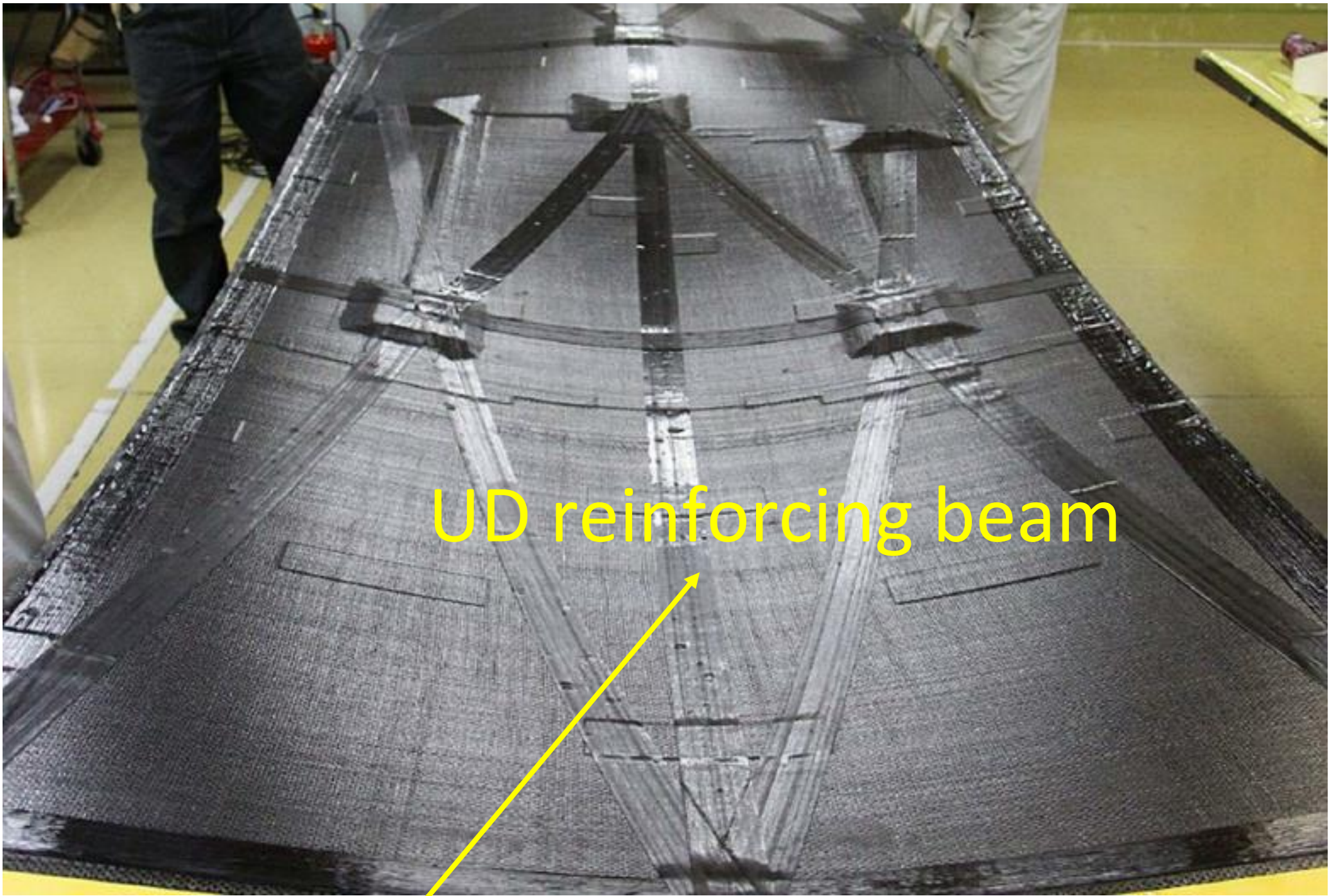


UD material is used as reinforcing beams to ensure rigidity

CFRP laminated configuration

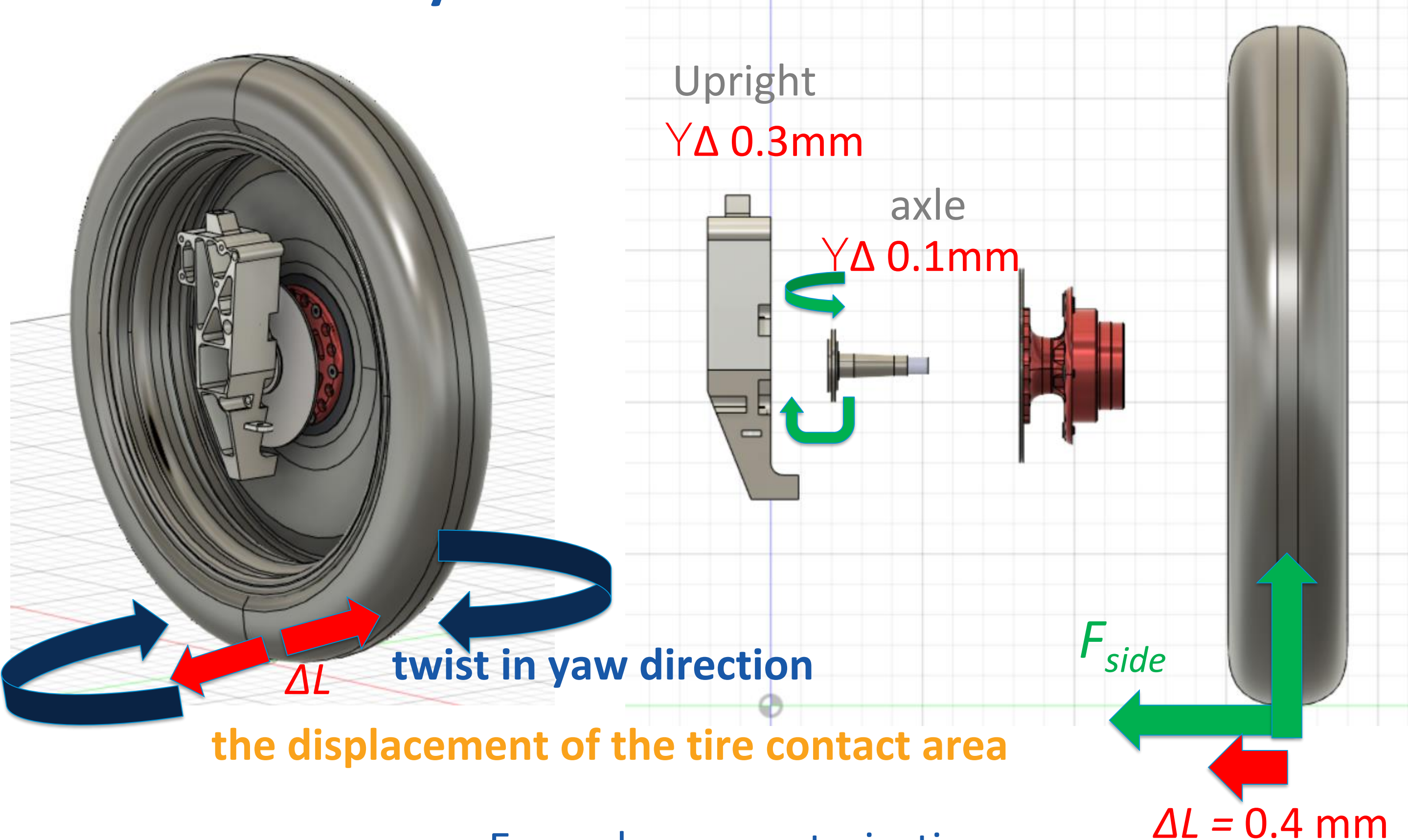
種類	配置	ply	厚さ[mm]
CFRP_1K		1	0.07
UD_中弾性		5	1.25
UD_高弾性		1	0.29
CFRP_1K		1	0.07
UD_中弾性		5	0.25
CFRP_3K		1	0.22
UD_中弾性		5	0.25

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**

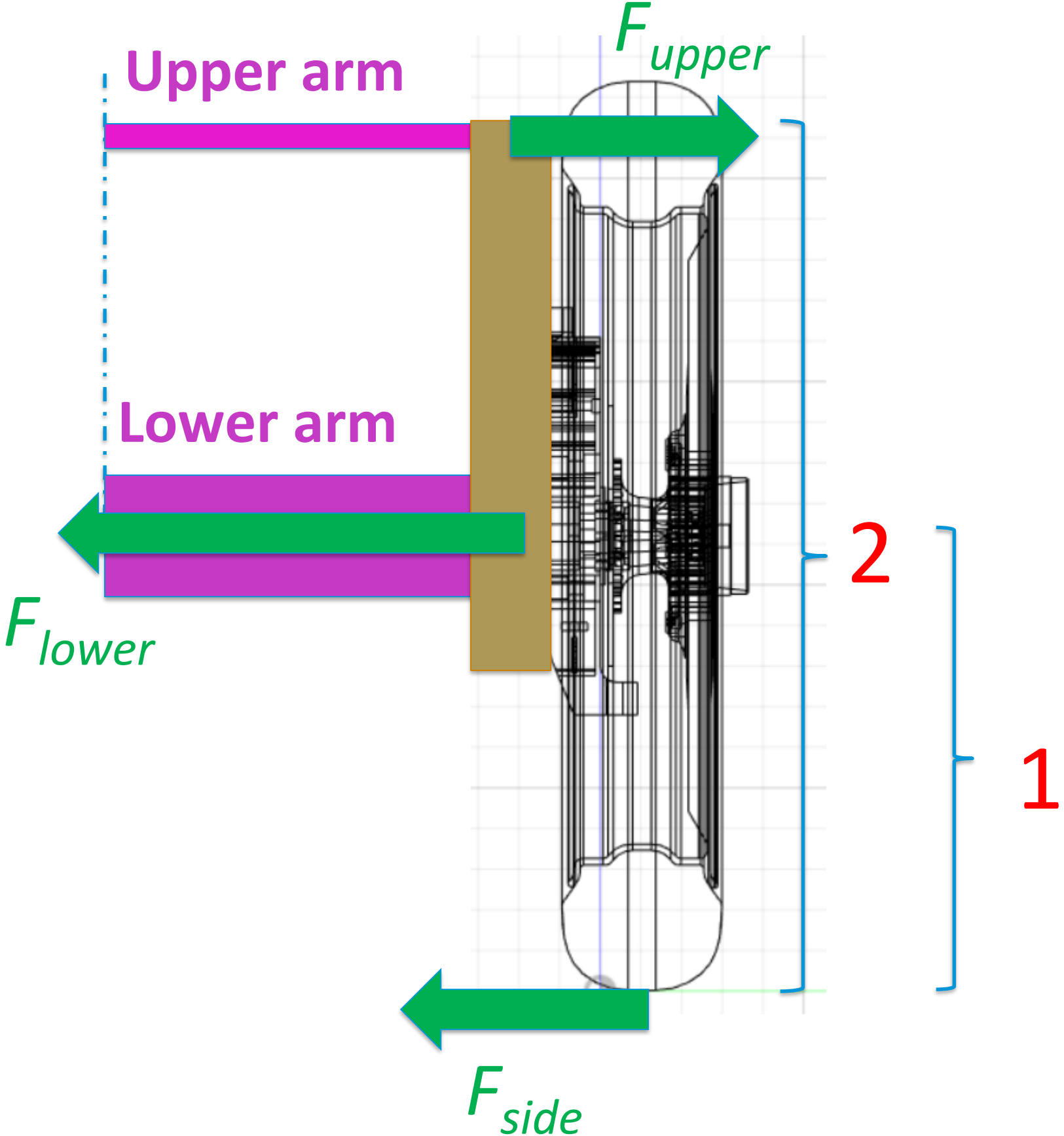


Example parameterization

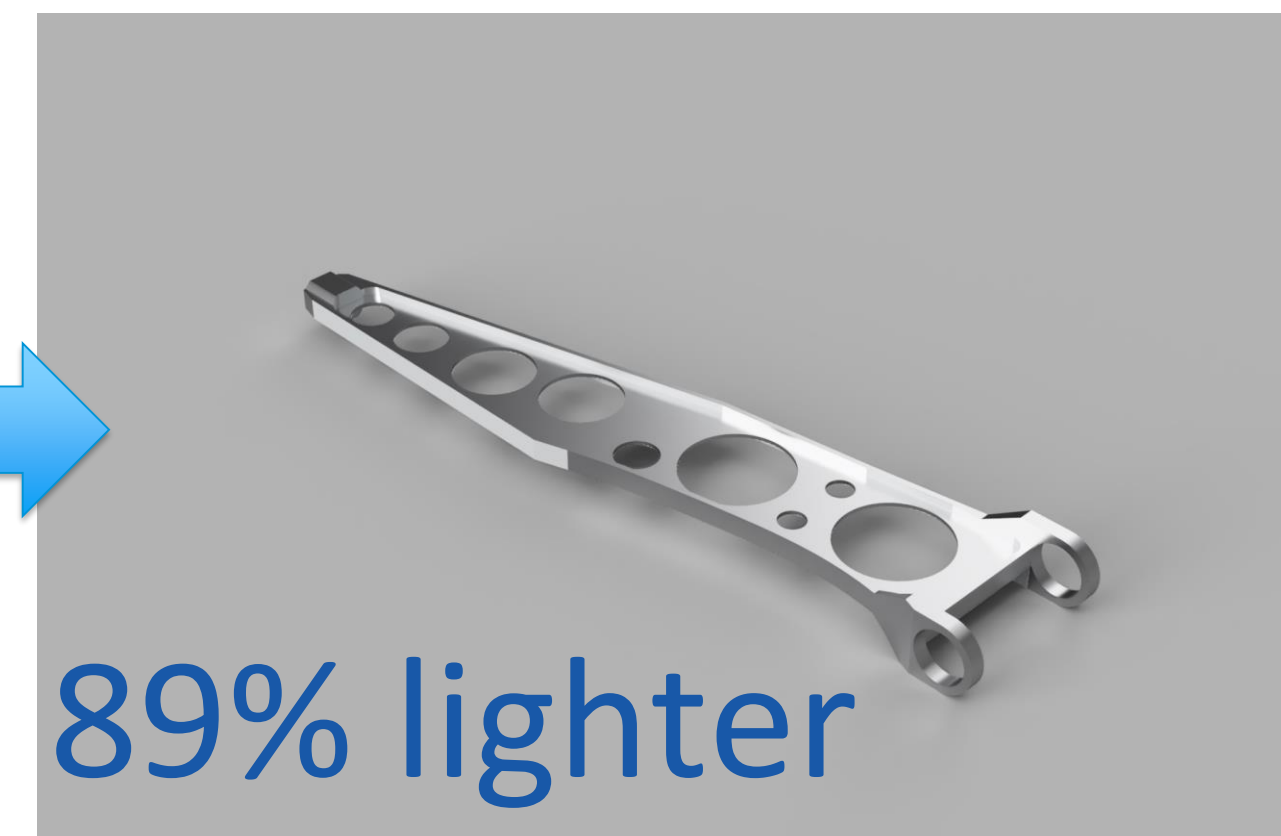
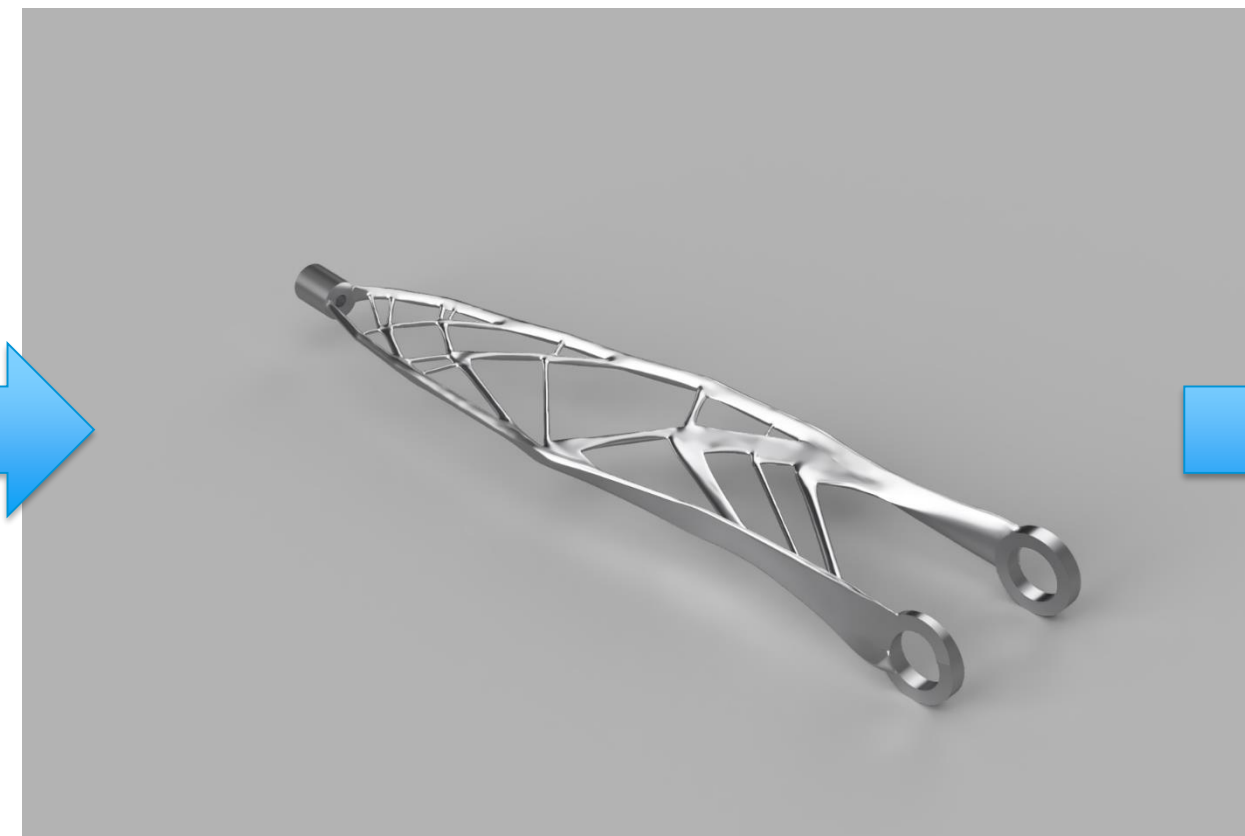
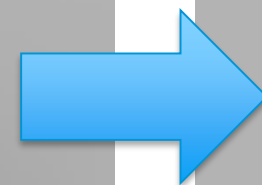
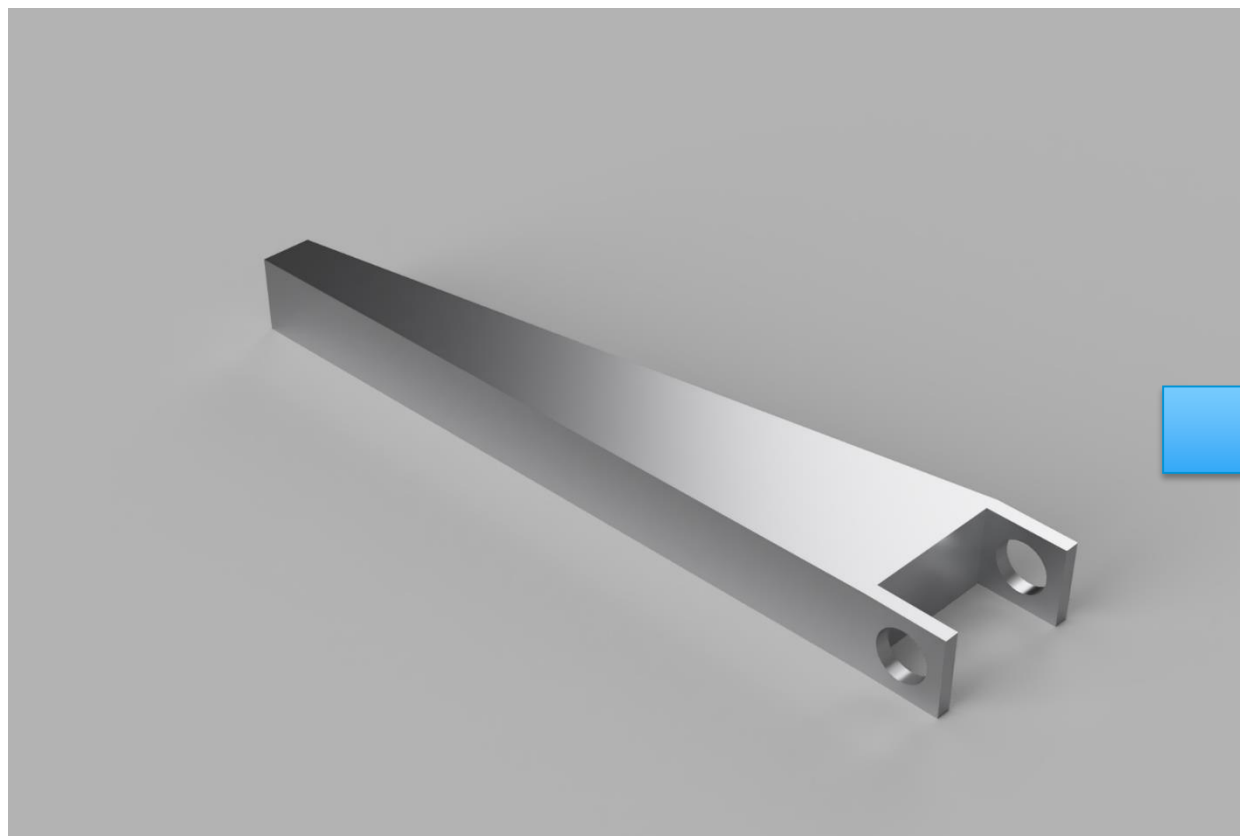
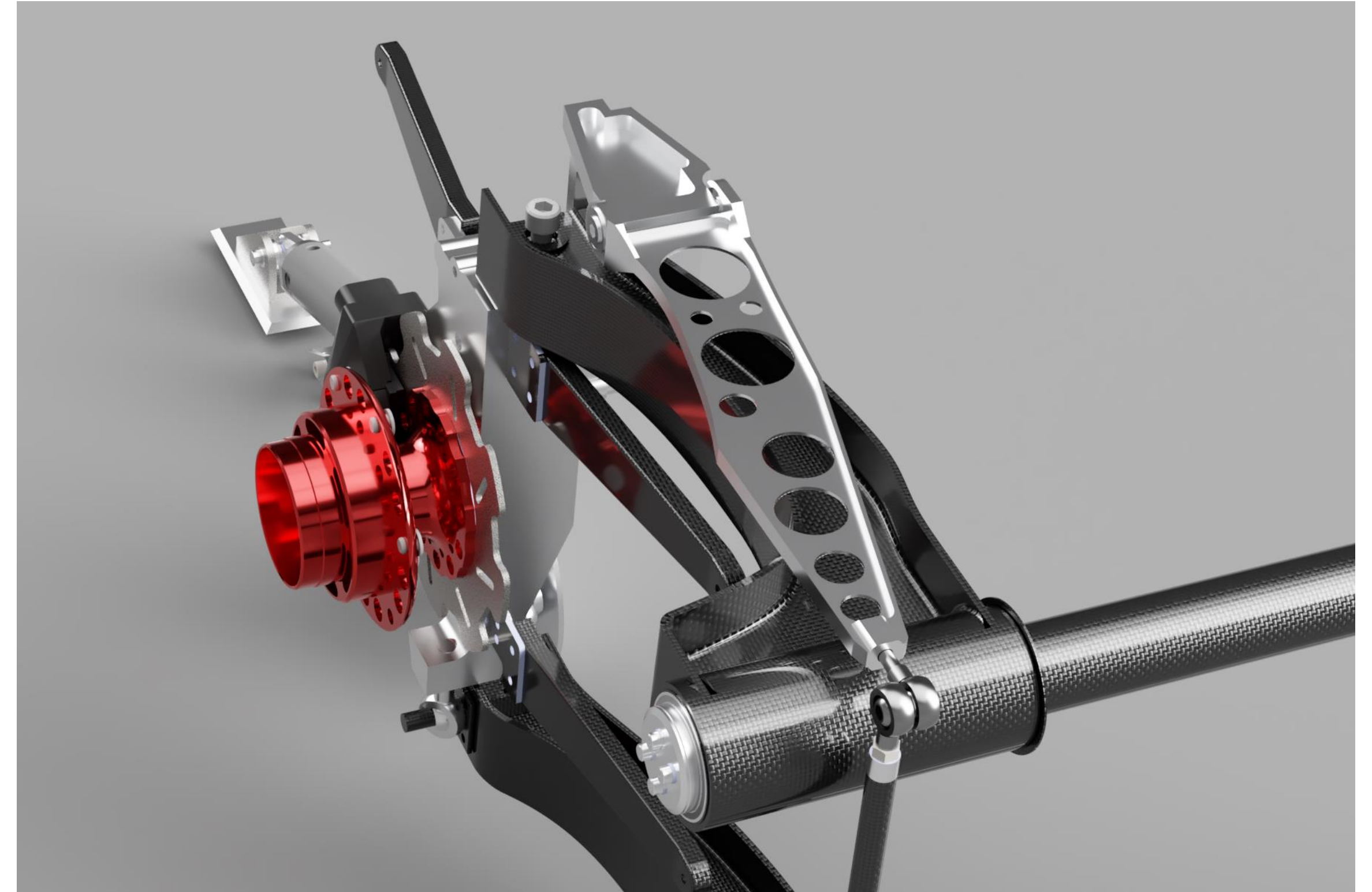
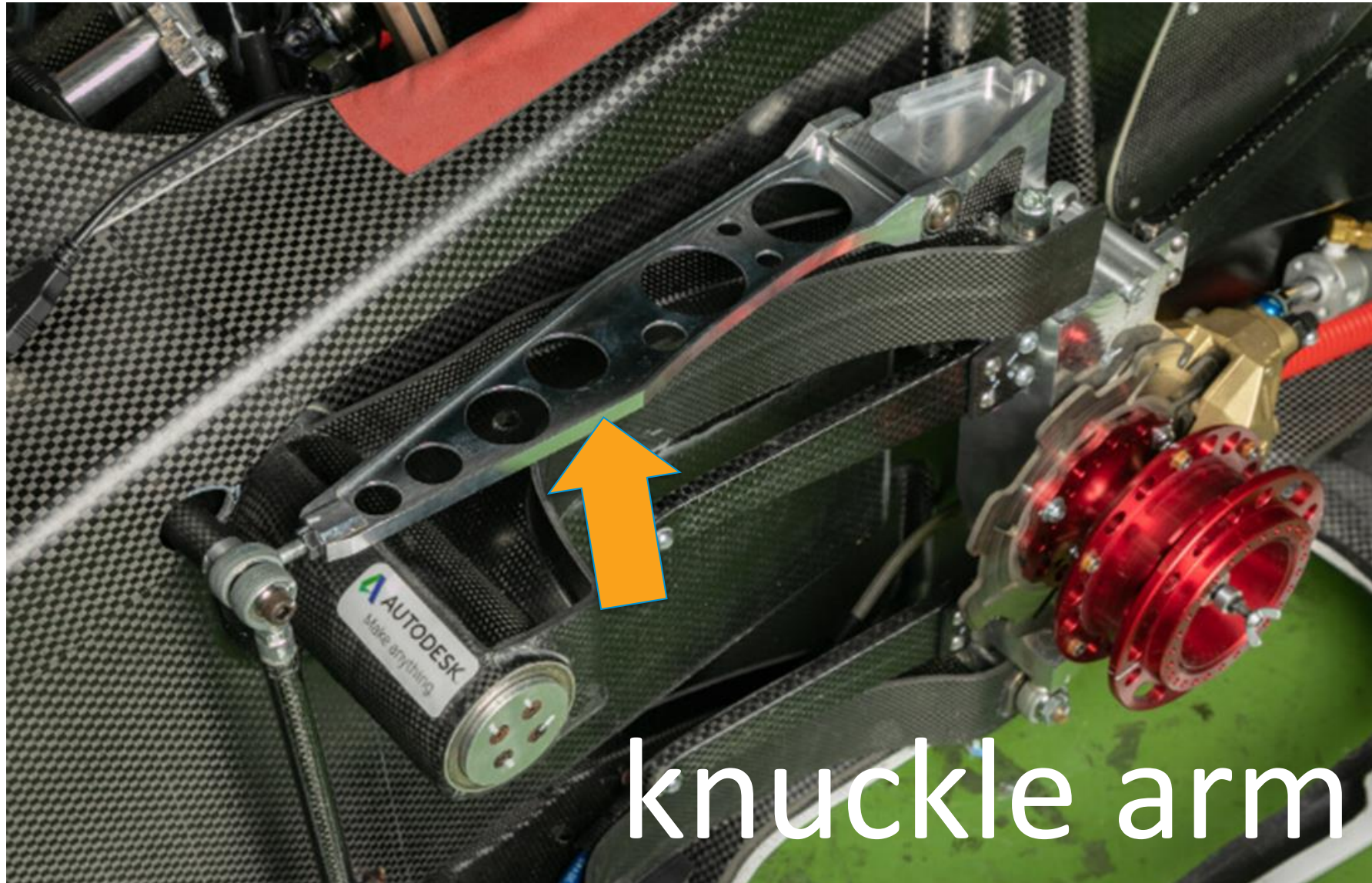
axle	+10g	displacement -0.1mm
upright	-20g	displacement +0.1mm
	-10g	0mm

MEMO: Arm stiffness

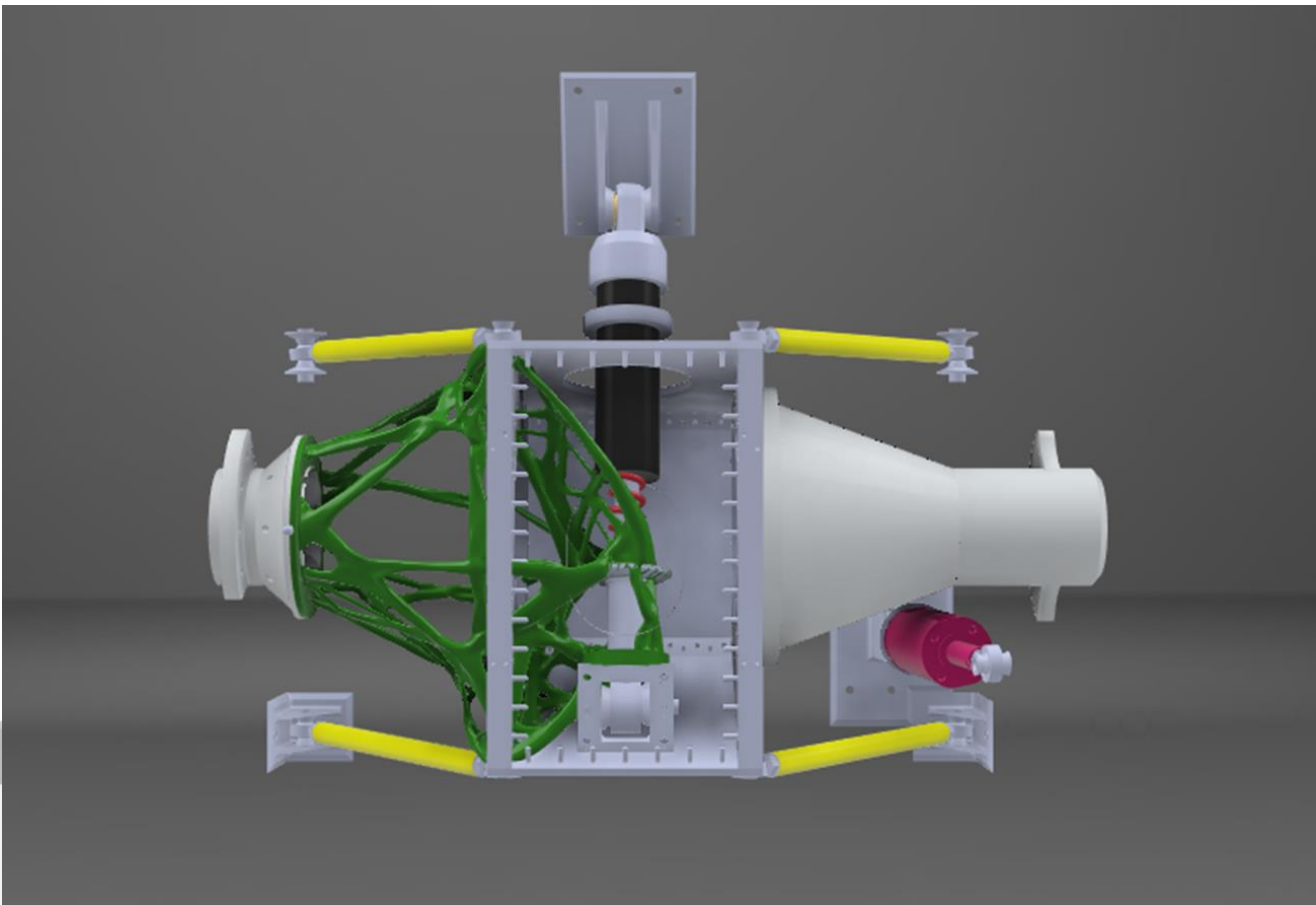
Lower arm >> Upper arm



Generative Design



Generative Design



Autodesk Fusion 360(教育機関ライセンス)

2020/09/25_11:51 v1*

検討

ジェネレーティブ
デザイン

表示

検討を終了

結果フィルタ

処理ステータス

スタディ

ビジュアルの類似性

デザイン ファイル

技術レビュー

製造方法

マテリアル

目標の範囲

体積 (mm³)

308,087.54

1.266e+6

質量 (kg)

0.859

3.418

最大フォンミーゼス応力 (MPa)

65.1

135.4

最小安全率

2.95

6.14

最大変位グローバル (mm)

0.21

40.89

最大変位 X (mm)

並べ替え基準

質量

スタディ 4 - Outcome 15

0.859 kg

スタディ 5 - Outcome 1

1.169 kg

スタディ 5 - Outcome 8

1.293 kg

スタディ 5 - Outcome 6

1.388 kg

スタディ 4 - Outcome 16

1.39 kg

スタディ 5 - Outcome 7

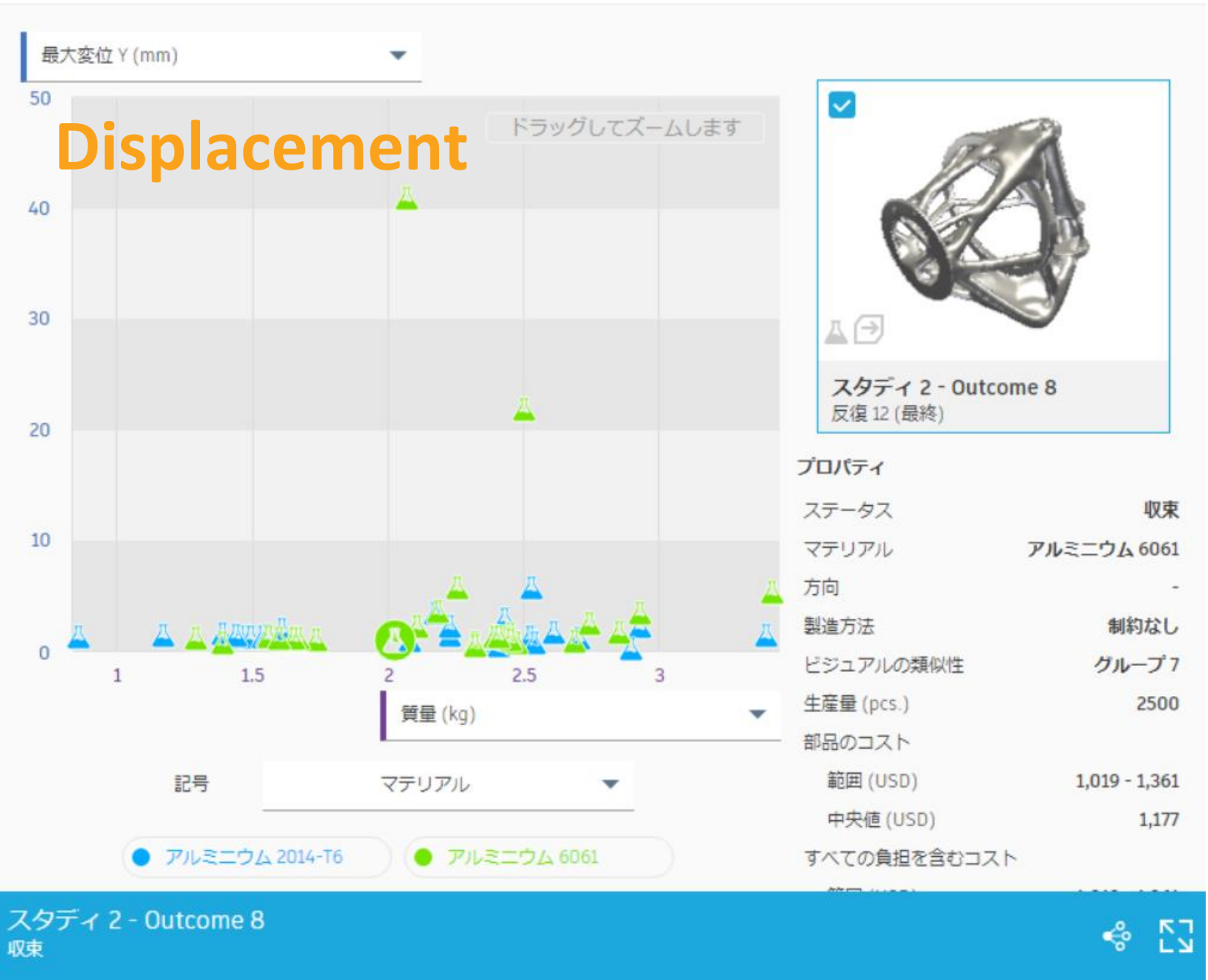
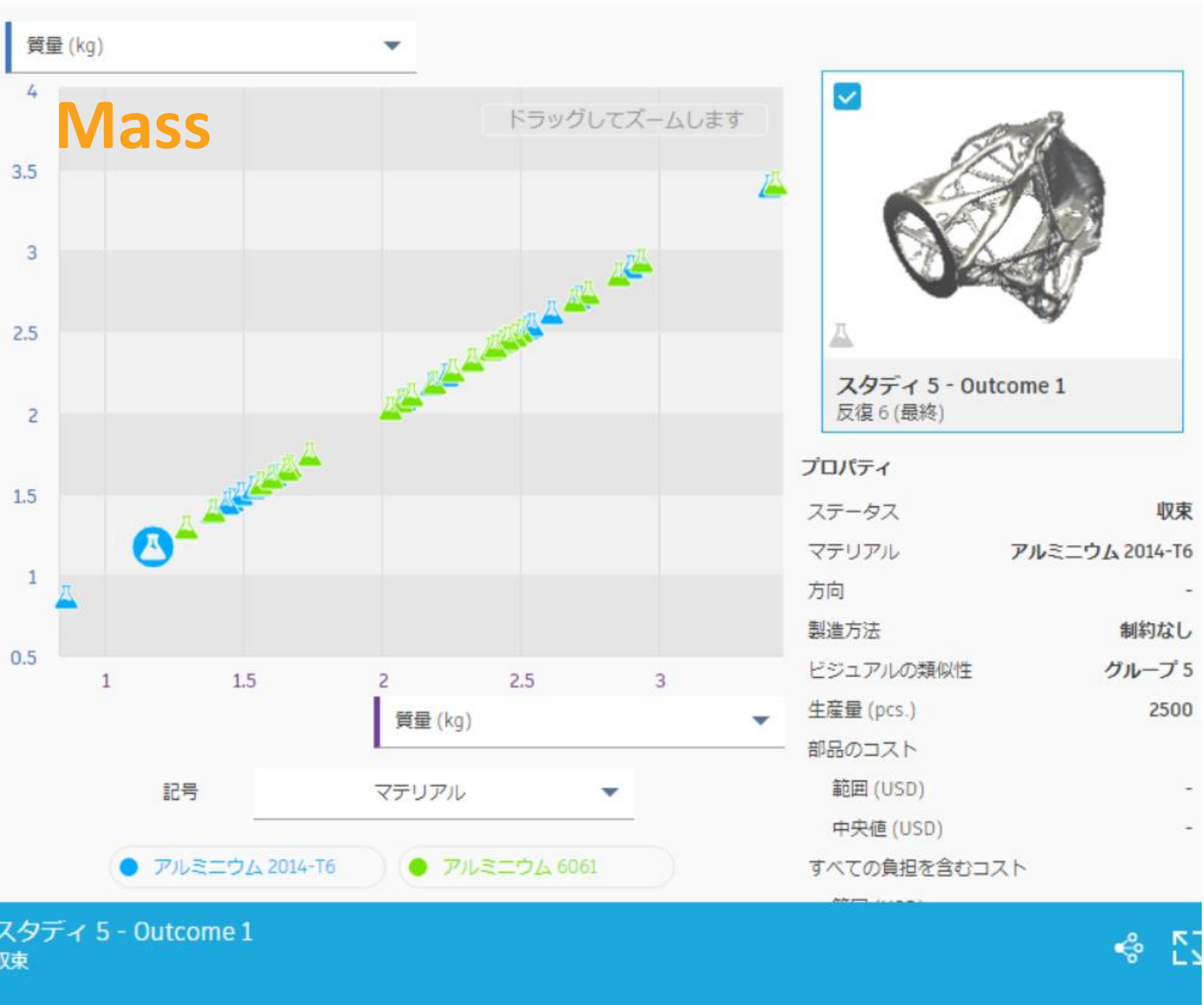
1.439 kg

スタディ 5 - Outcome 3

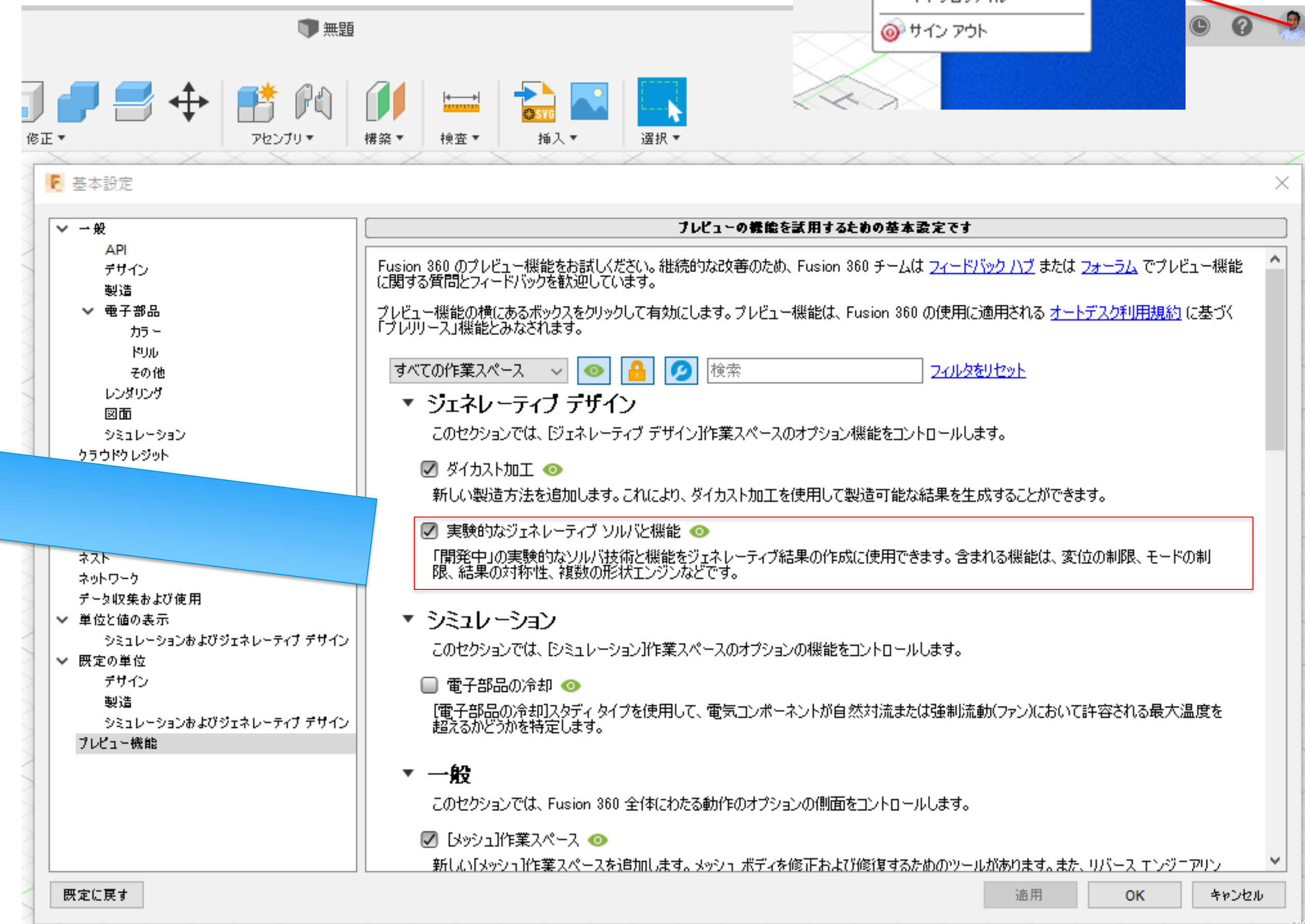
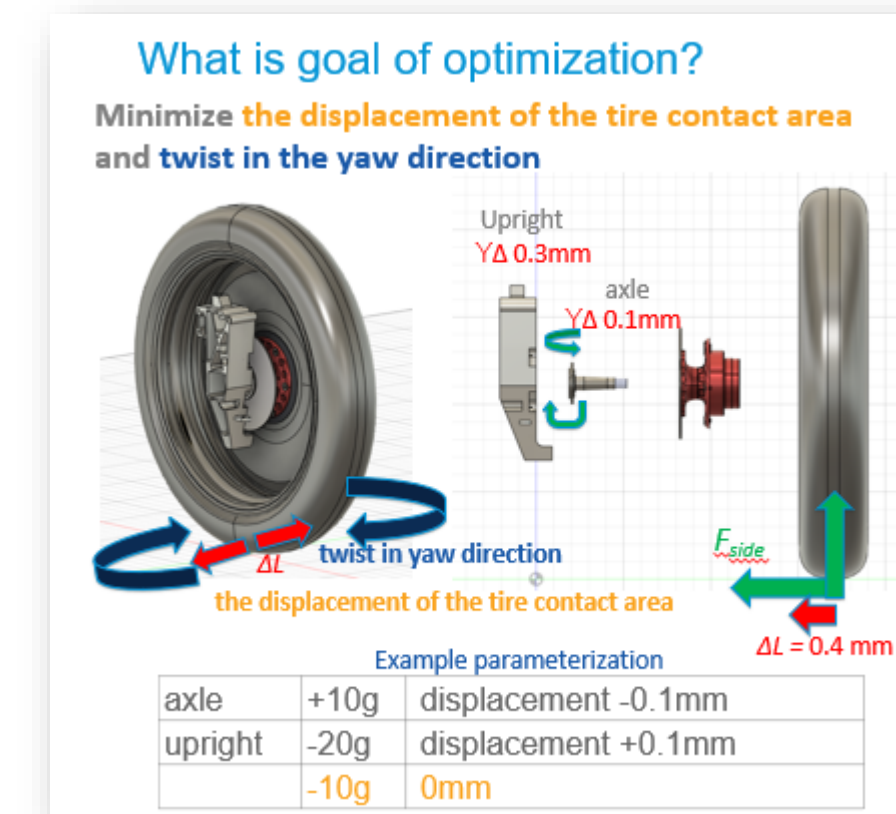
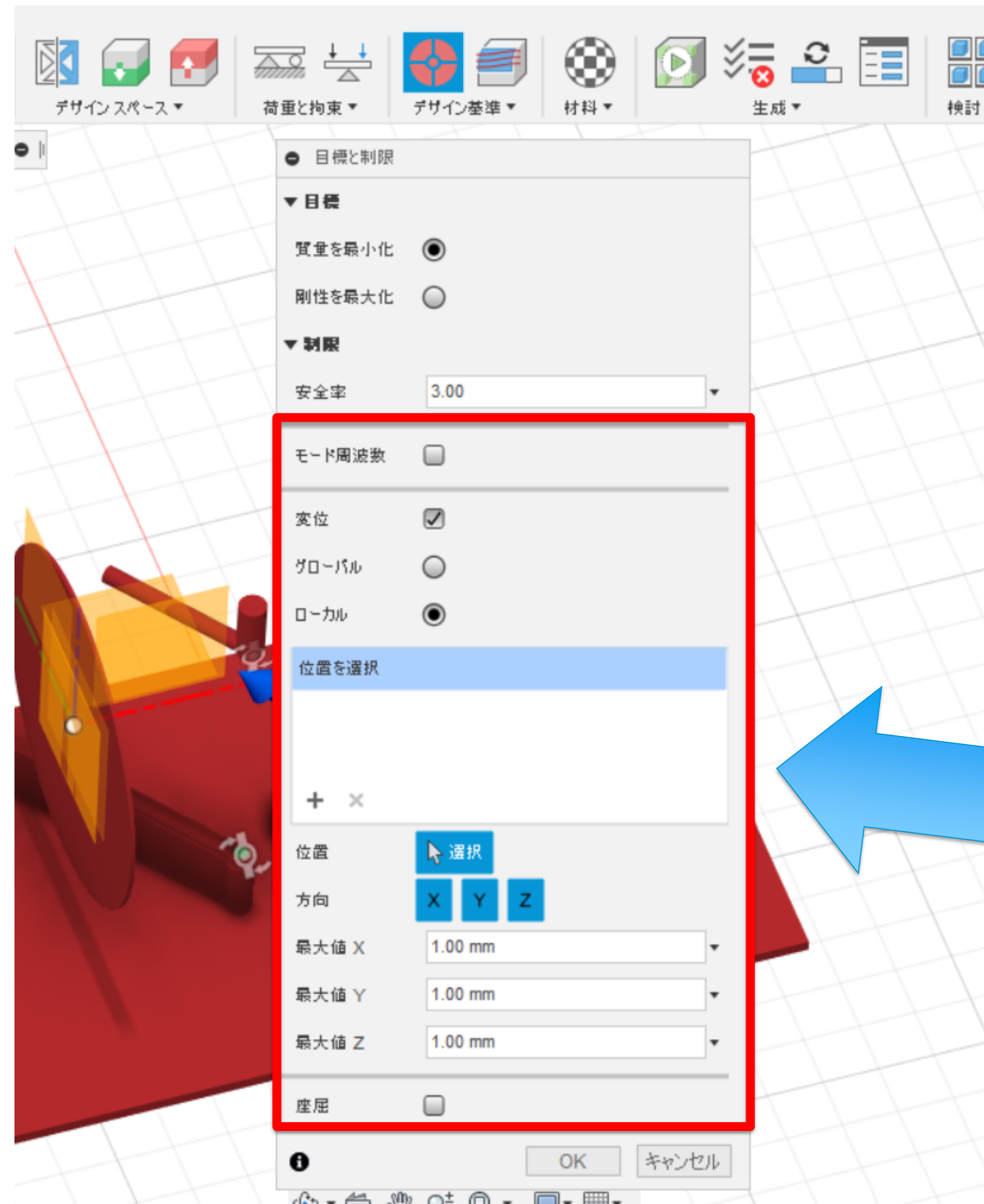
1.455 kg

スタディ 5 - Outcome 4

1.493 kg



Advanced setting for Generative Design

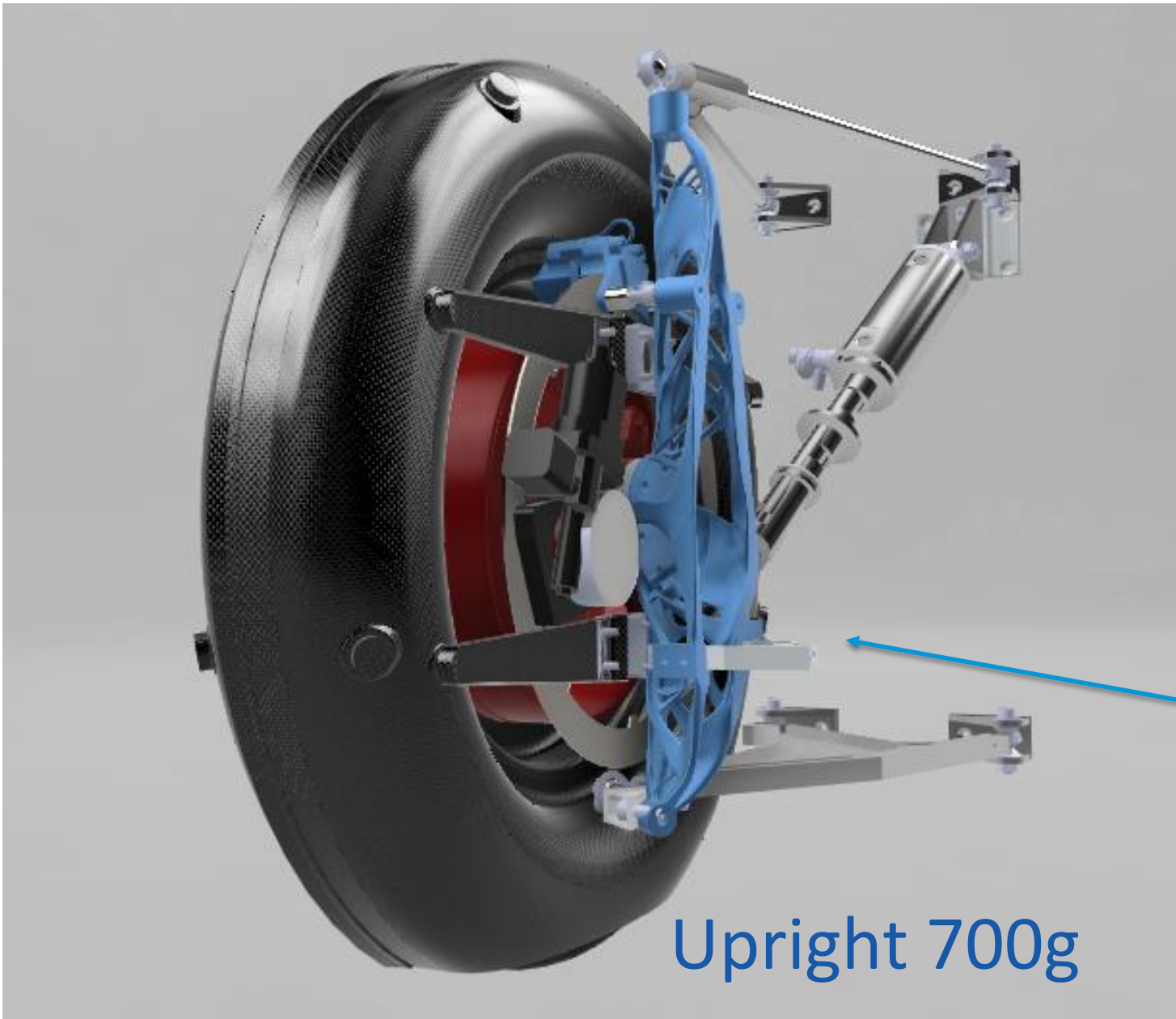


Samples of our past cars

5th car
Rear
Swing Sus

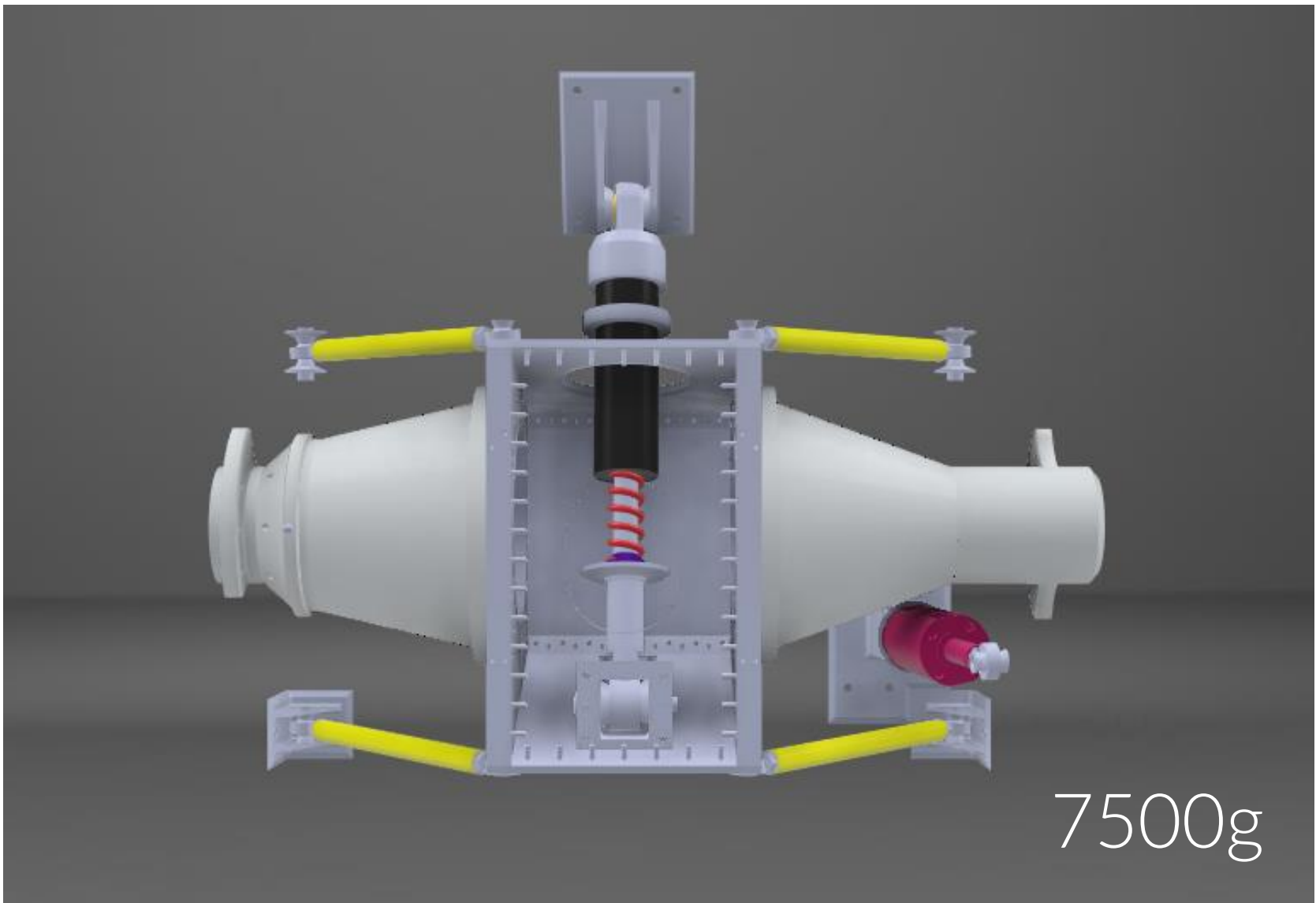


lightweight
➡
-36%

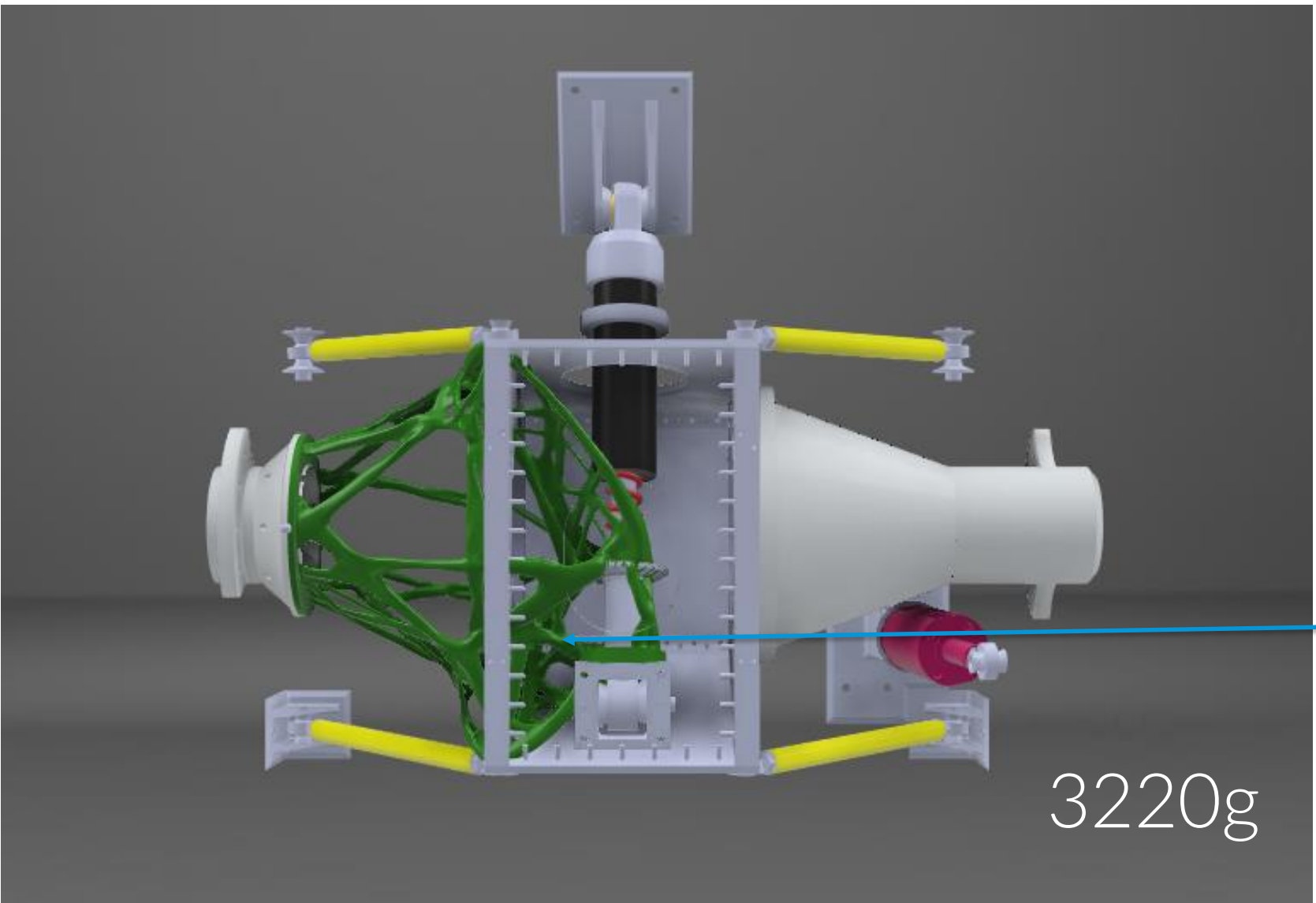


Lower parts
High rigidity

4th car
Rear
Rigid Sus



lightweight
➡
-57%

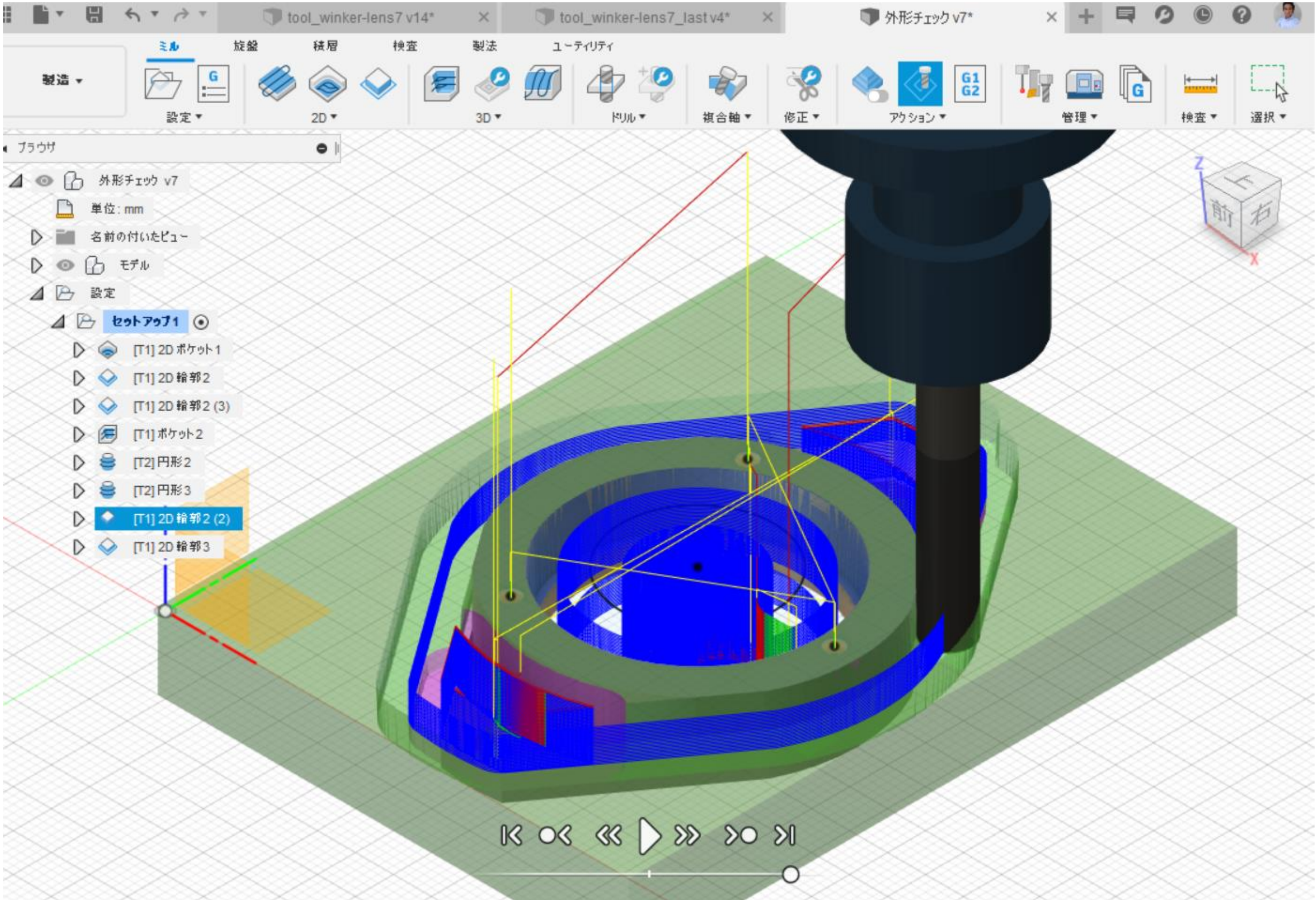
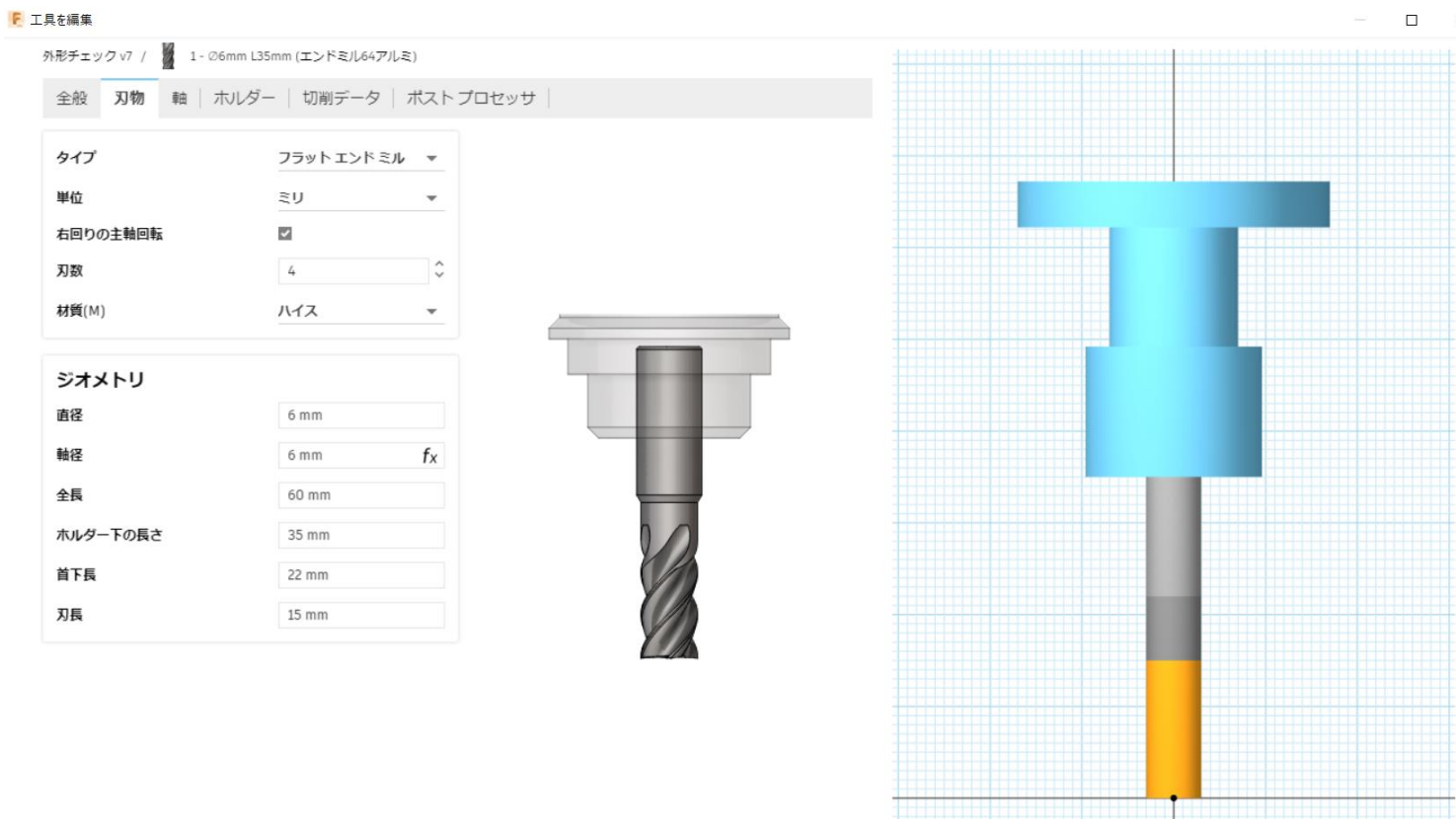


Lower parts
high rigidity

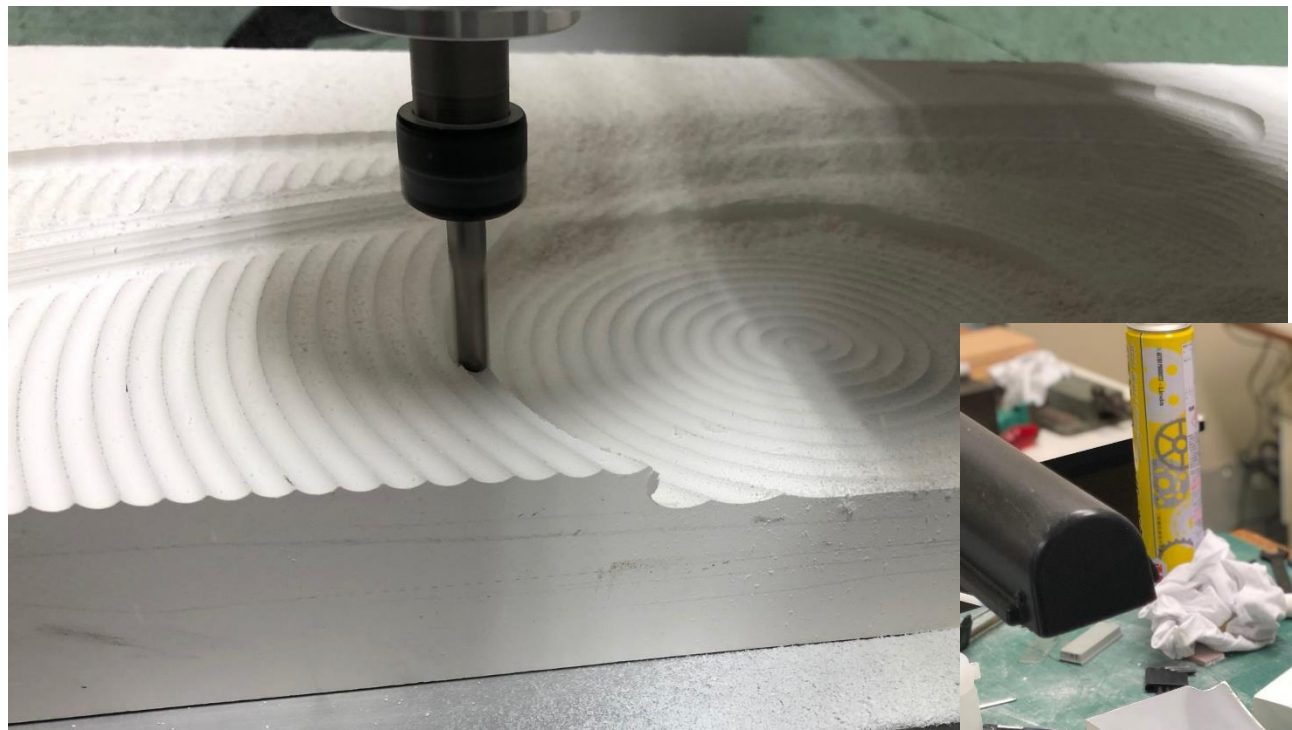
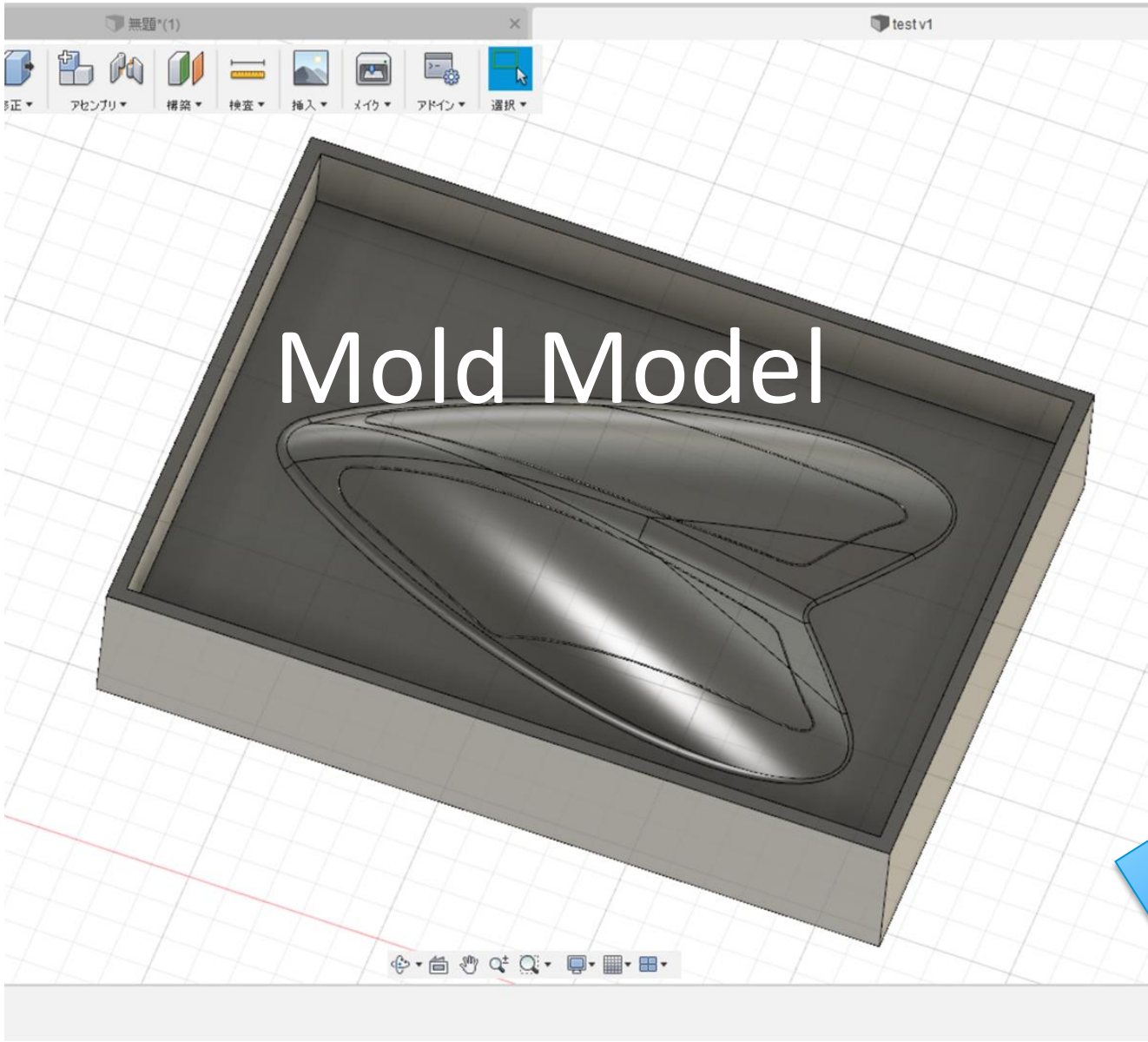


CAM with Fusion 360

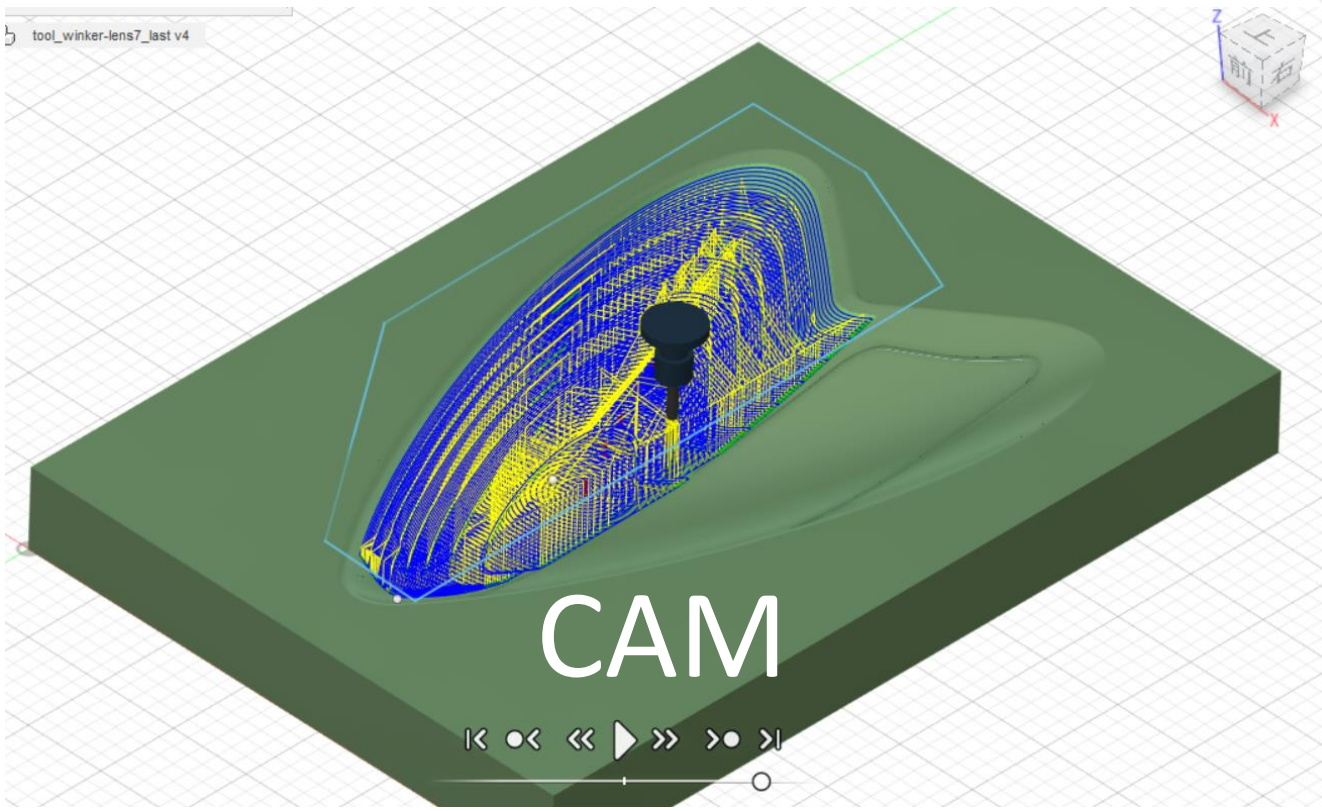
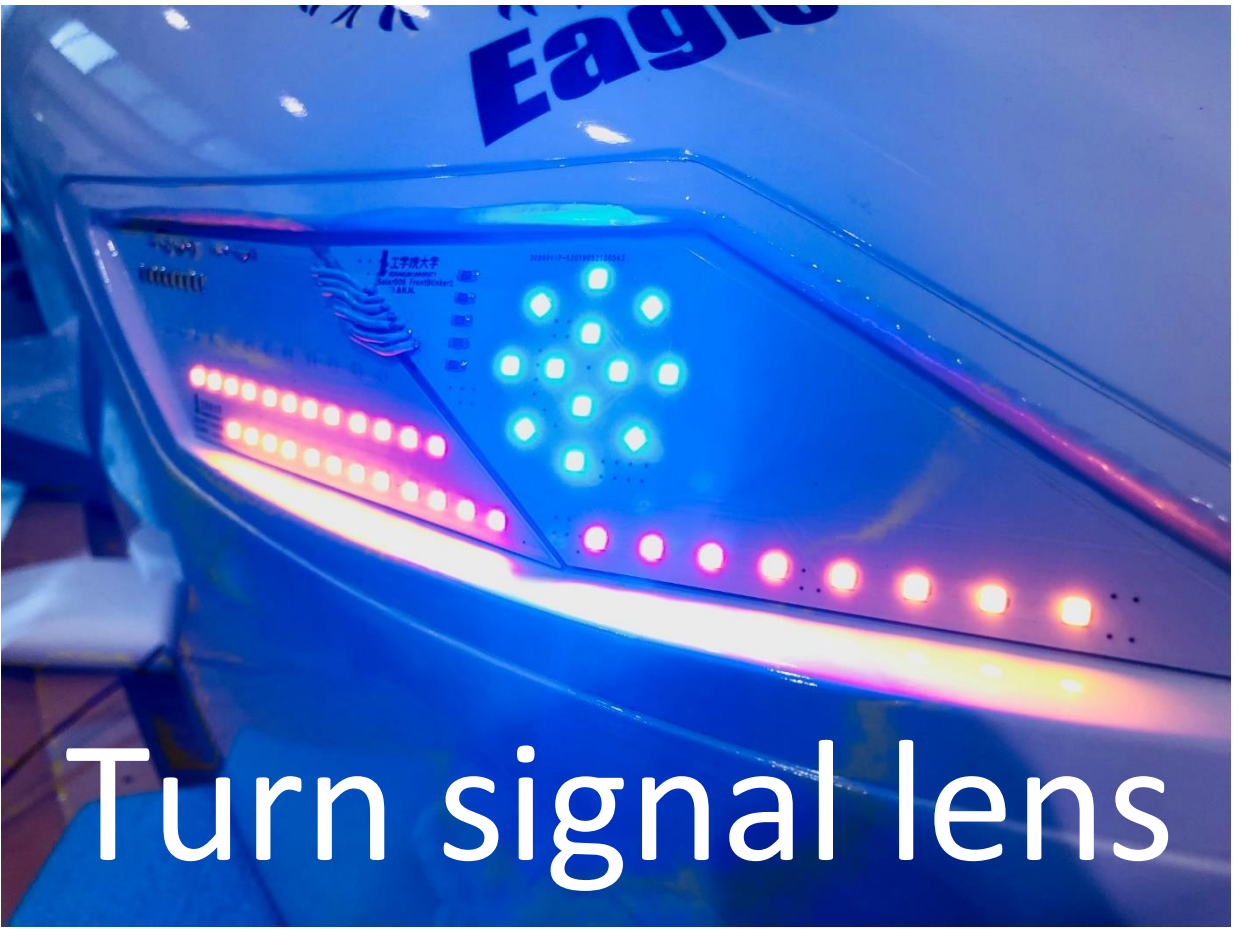
1/13 time reduction



CAM for Mold, CFRP, Polycarbonate and PET



Thermoforming



Laminate CFRP

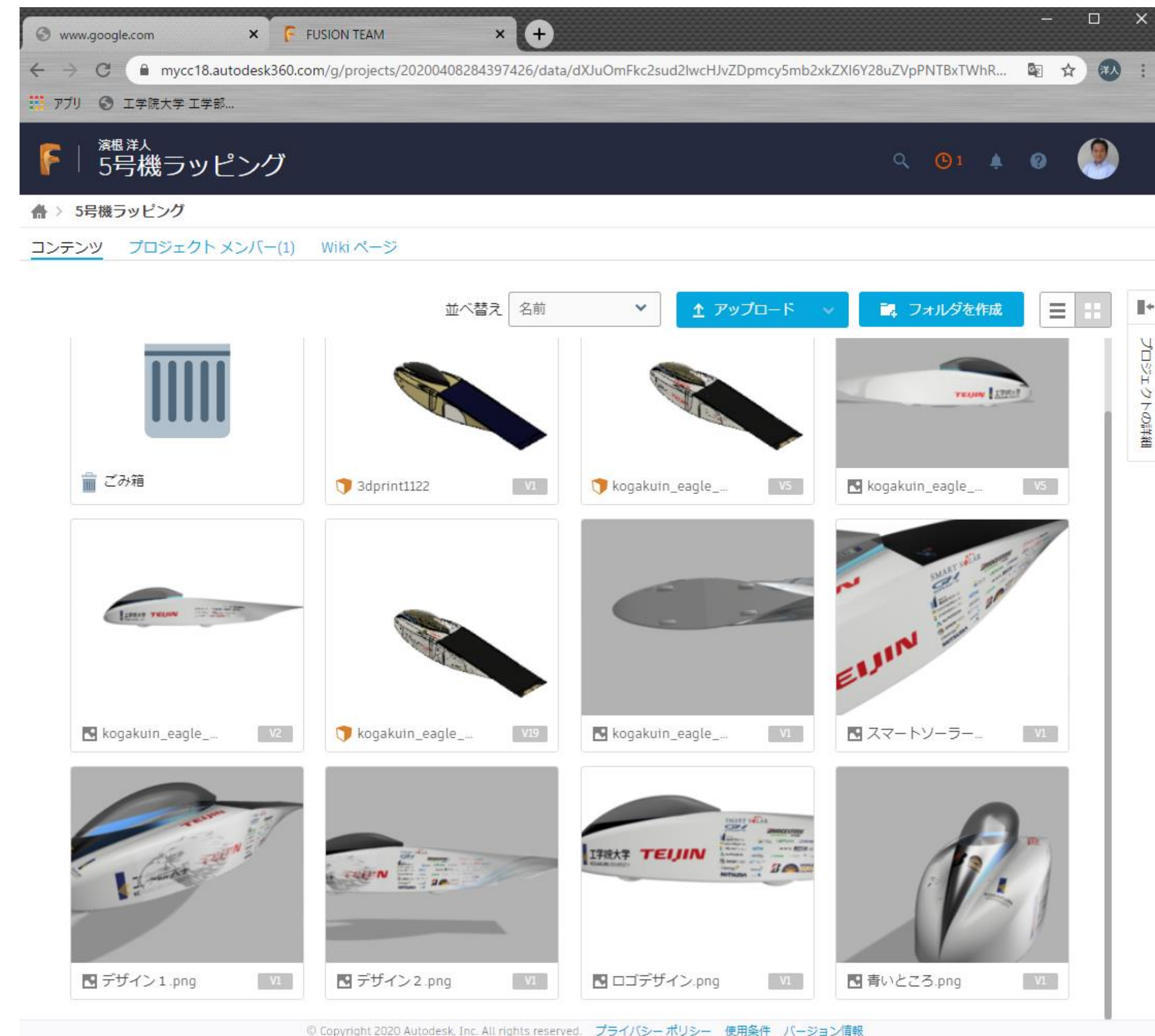


Rendering: Car wrapping proposals

Rendering for beautiful posters



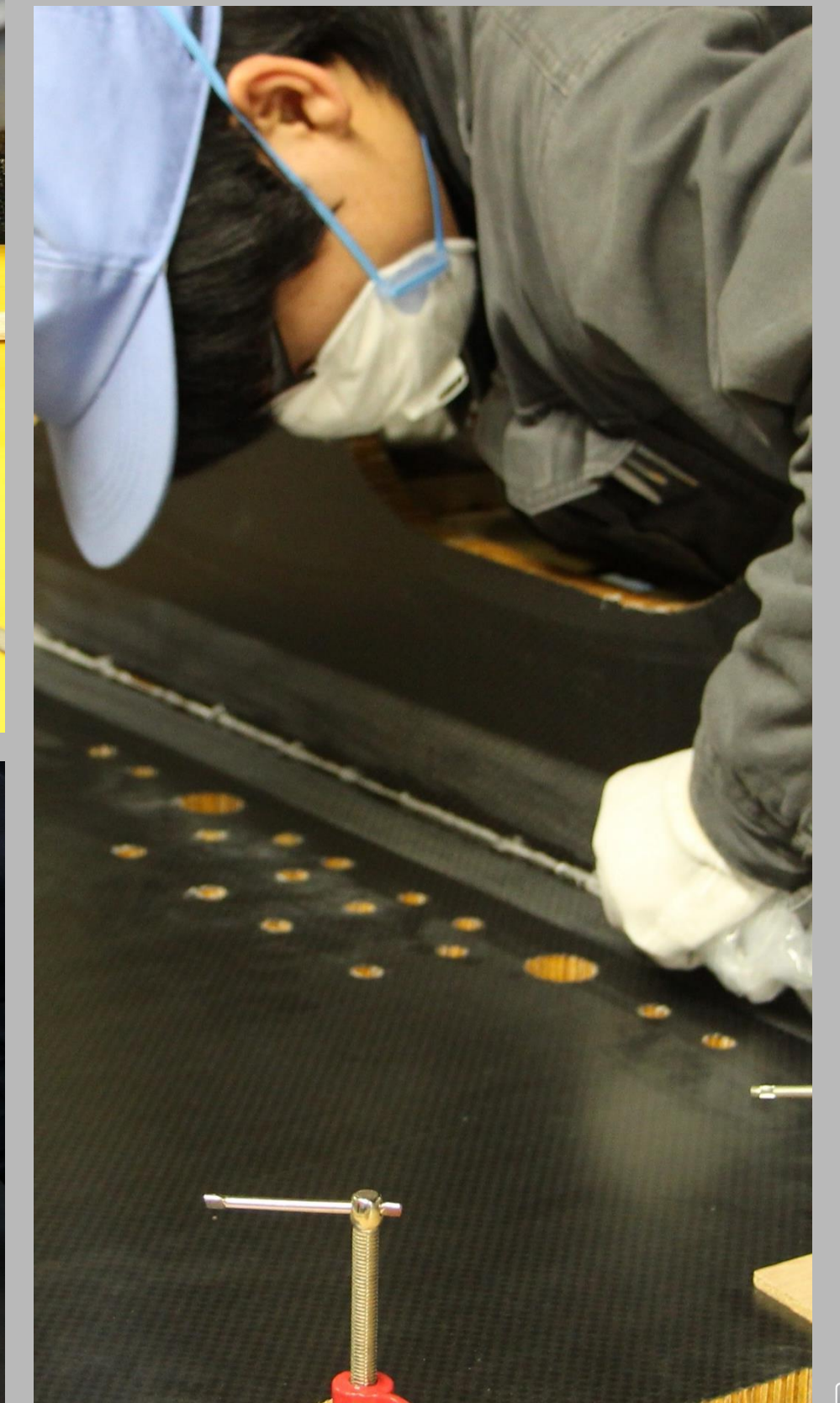
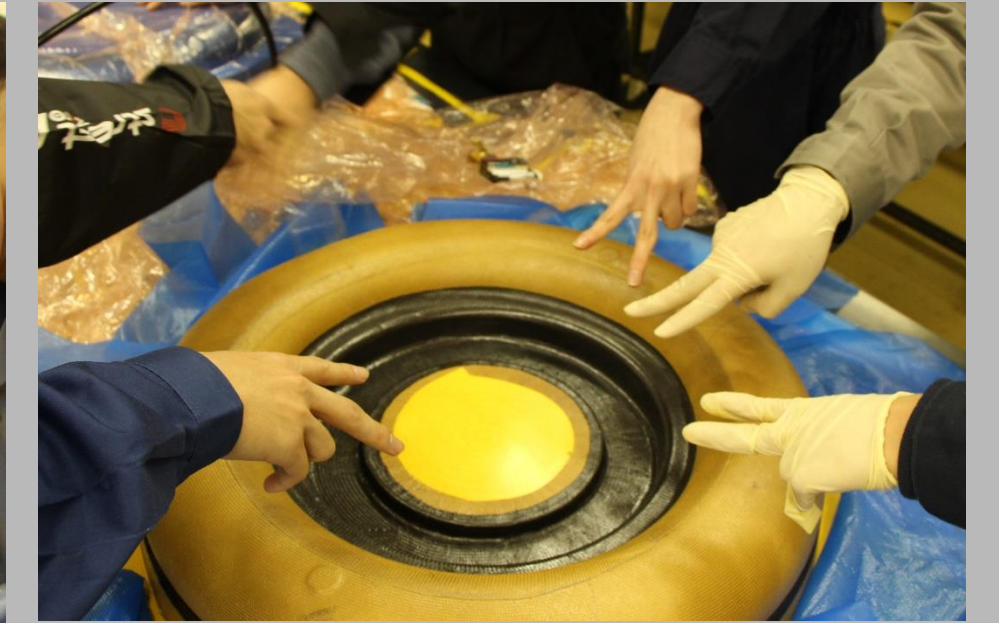
Publish the proposal to members on the WEB



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



Realization





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