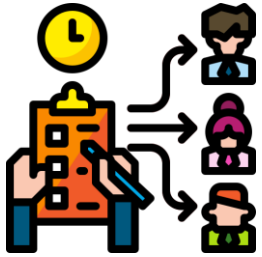
Computer Aided Design

Microscopic Mosquito Robot

간지러버 팀

Contents

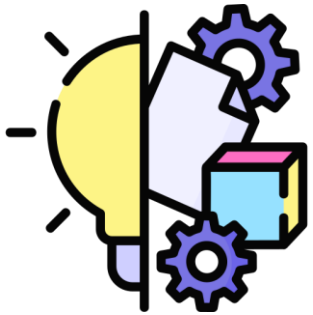


01 Topic & Part Divide

- Part in charge
- Background

02 Project Specification

- Part Design
  (head, body, wing, legs)
- Assembly & DMU Kinematics



03 Result & Difficulty

- Resultant
- Difficulty

04 Q & A

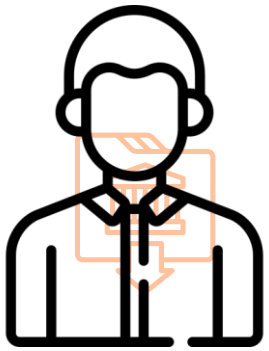
- Video

Computer Aided Design

Part 1

Topic & Part Divide

01 Part Divide



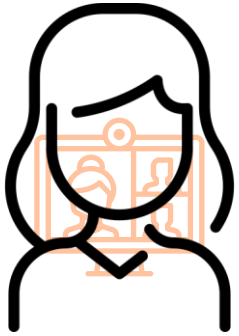
류승지

-아이디어 제안

-자료 수집

-모기의 머리 Design

-DMU Kinematics



이예진

-자료 수집

-모기의 몸통과 날개 Design

-PPT Design 및 Template 선정

-영상 편집

홍승한

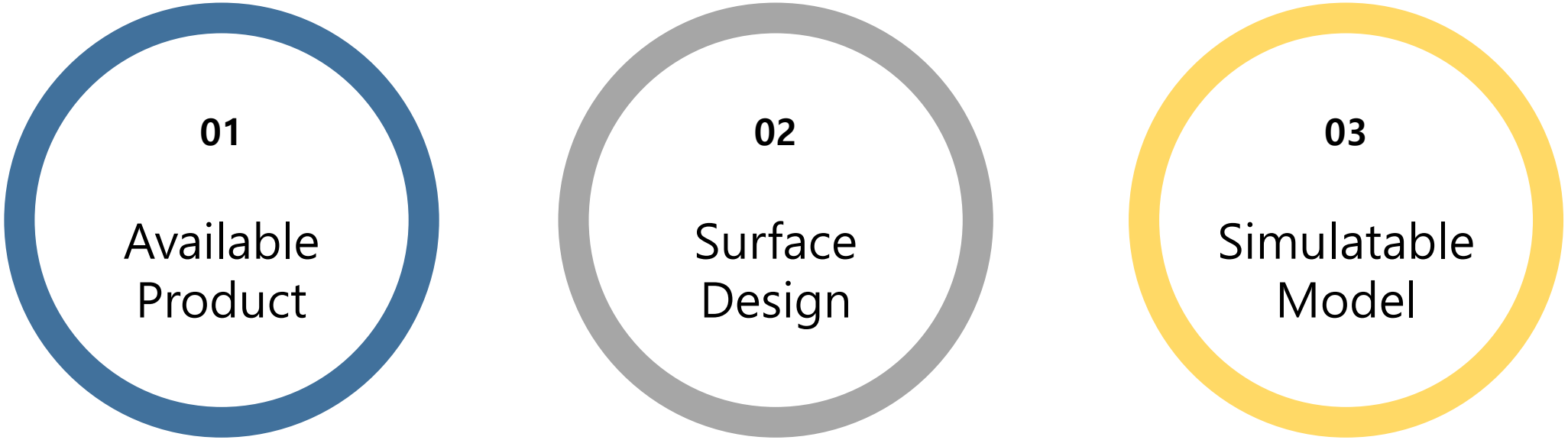
- 자료 수집 & 팀 이름 제안

- 다리 Design & Assemble

- PPT Design 및 발표

- 영상 편집

Background



움직이는 초소형 **곤충** 로봇

Microscopic Mosquito Robot (MMR)

01 Topic

- CATIA Design 은 AM 방식에 유용함

- 기존의 주조 방식보다 적합함

- Microscopic Robot을 만들 때 AM 방식 적합

Ex) Fabrica Company에서 개발 중

Why should manufacturers be interested in micro AM?

Well put quite simply, because of the impact the use of AM can have on OEMs looking to produce innovative products economically and in a timely fashion. Through use of the Fabrica 2.0, for the first time micro manufacturers can now realistically assess a shift to AM from conventional manufacturing processes. OEMs can therefore benefit from the inherent advantages that AM offers in terms of promoting part complexity with no increase in cost, eliminating the needs for expensive tooling, reducing part counts and the need for assembly, speeding product development time, easy revision of part design, mass customization, reduction in waste, and reduction in energy costs.

CATIA V5

- 초소형에 적합한 모기

- 화학 무기로도 사용 가능

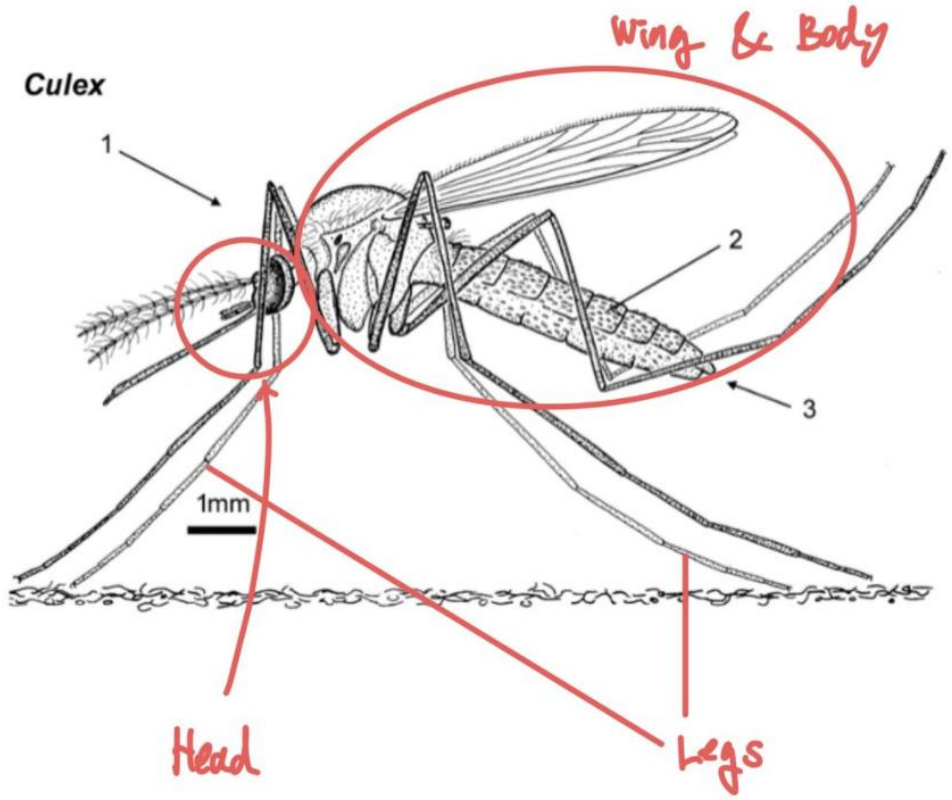
- 로봇은 다량의 part 생성
-> CATIA 다양한 기능 사용
-> 관절 부분에는 Assembly, DMU 활용이 가능

MMR Robot

Mosquito Robot

Part Divide

- Part Design 분담에도 편리할 것이라 생각
(Head / Body & Wing / Leg)



3부분으로 나누어서 진행

1. Head

2. Wing & Body

3. Legs

01 Topic

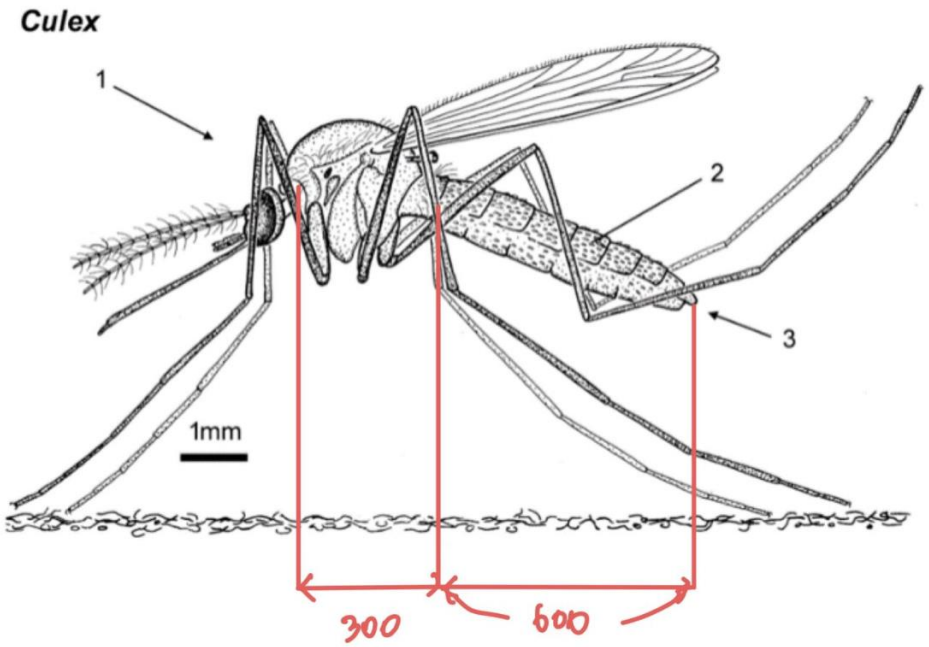
Adult Mosquito Size

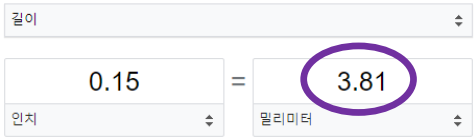
How Big Are Mosquitoes?

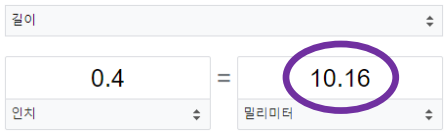
The size of mosquito adults are species-specific, meaning size depends upon the species and also somewhat by the nutritional conditions of the larvae's aquatic environment.

Less Than an Inch Long

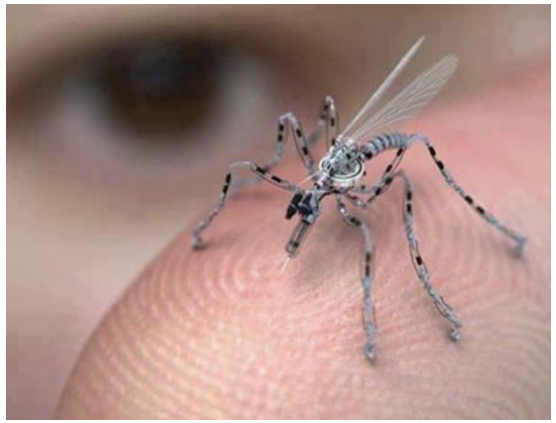
In general, adult mosquitoes are relatively small insects that generally are about 0.15– 0.4 inches long, although some species can be less than 0.1 inches long. However, most mosquito adults commonly encountered are close to the same size.







Scale = (Real Size) X 100

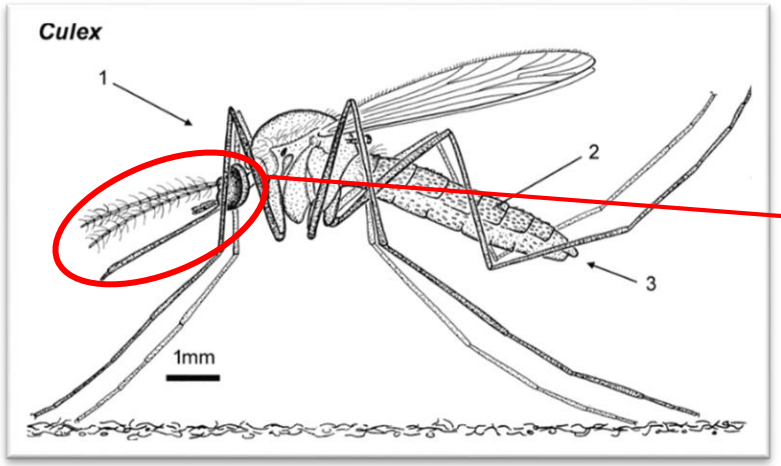


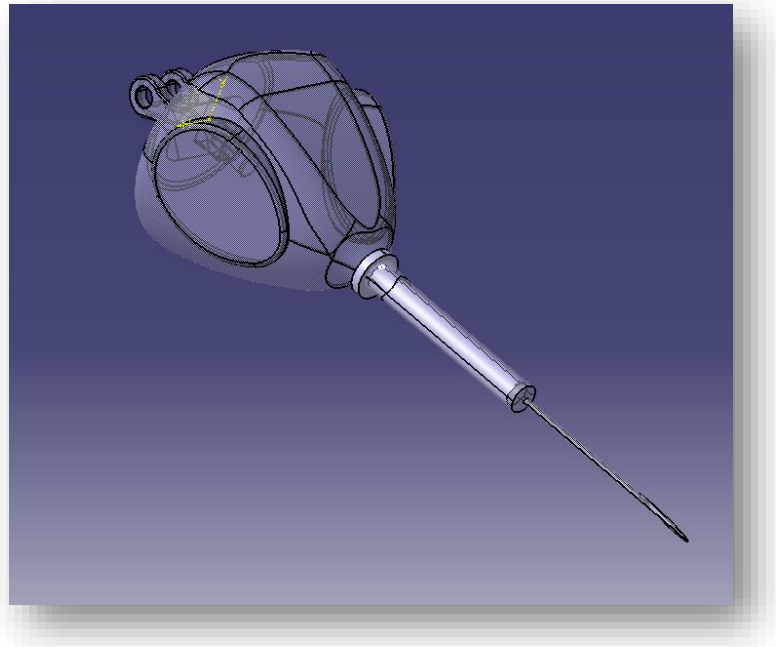
Moving Microscopic Mosquito Robot

Computer Aided Design

Part 2

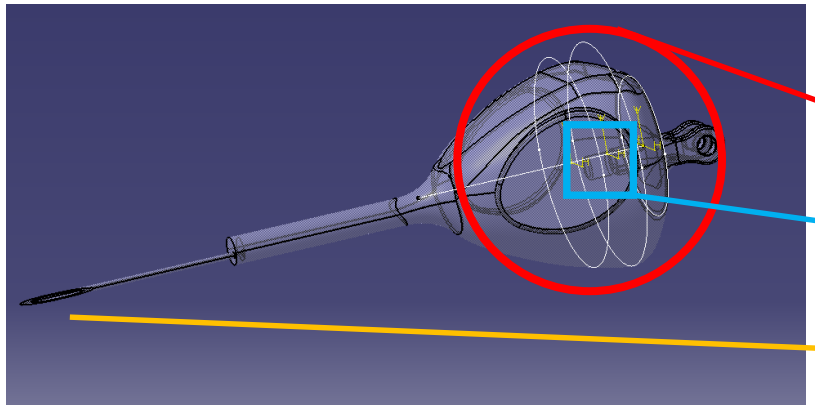
Project Specification





Head Part

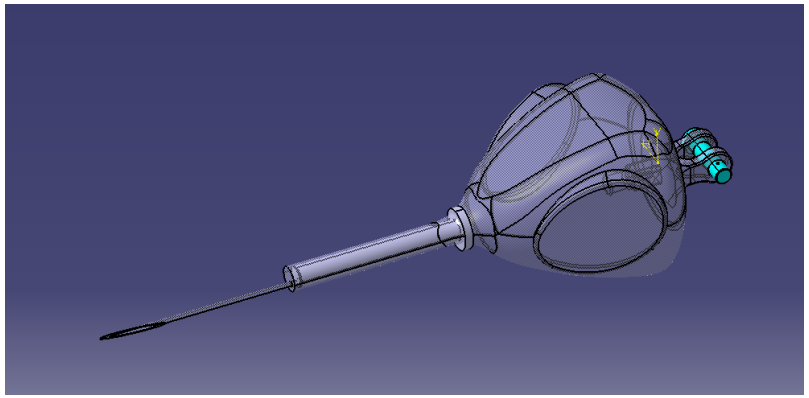
02 Part Design - Head



- Multi-Sections Solid, Mirror, Fillet 등의 기능 사용

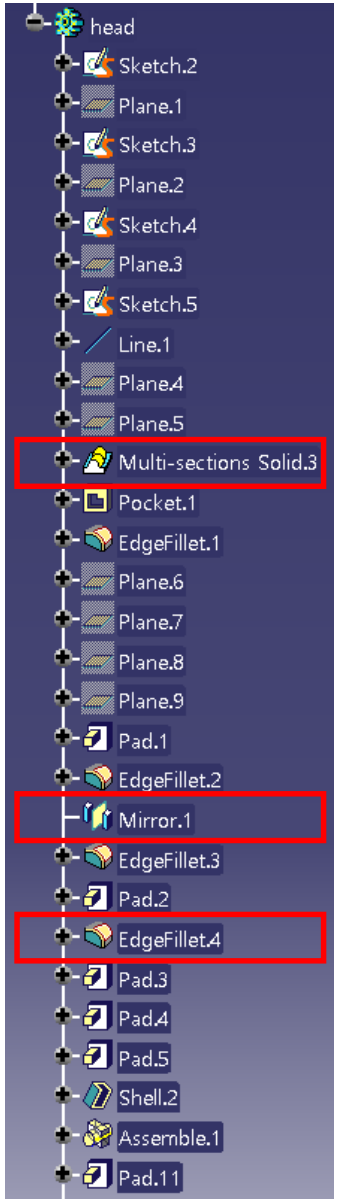
- Head의 평면을 기준으로 대칭적으로 디자인

- 모기의 침(Sting)은 날카롭게 비스듬한 각도로 자름

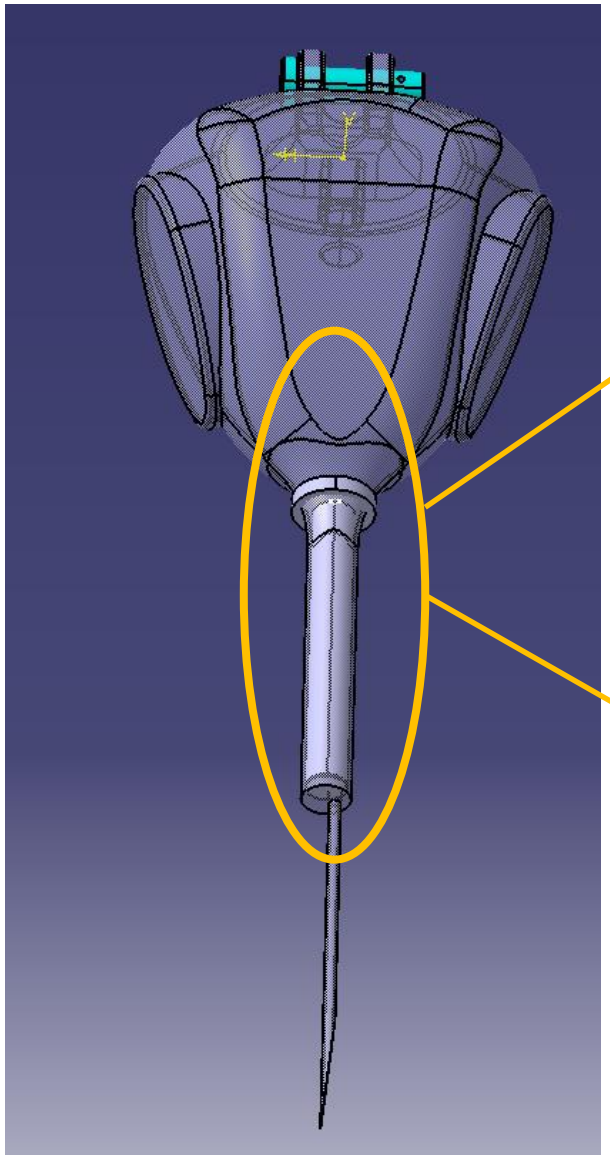


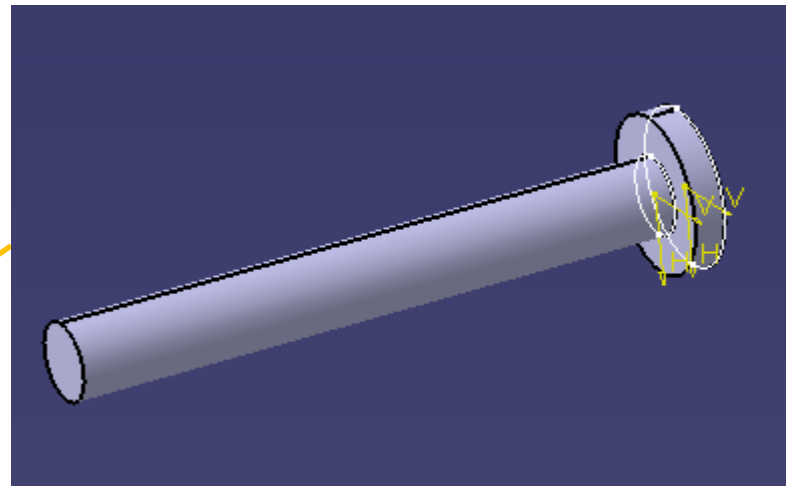
모기의 침(sting) 역시 실제 크기인

50 micro meter의 100배인 **5mm** 로 적용

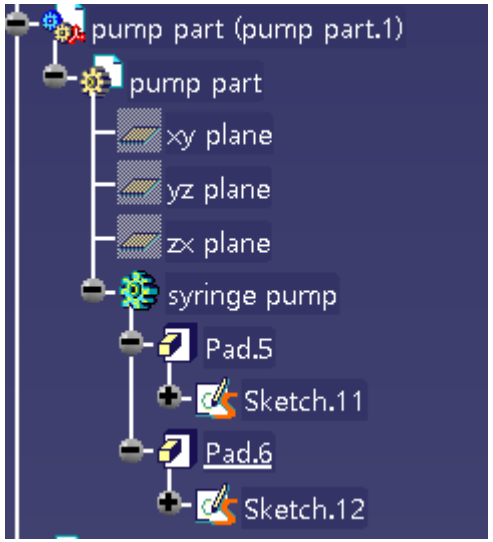


02 Part Design – Head(Piston)



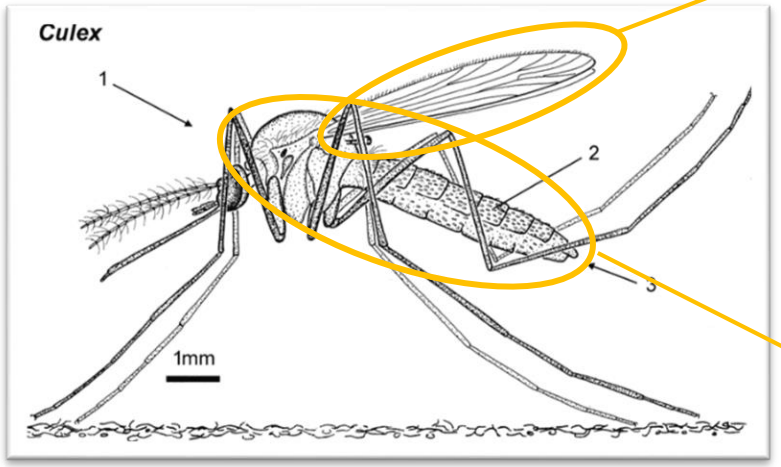


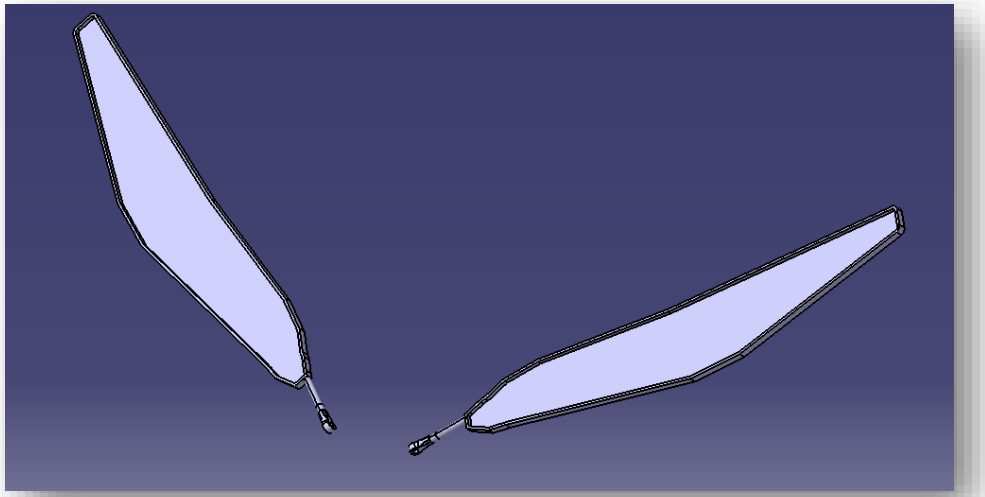
Piston

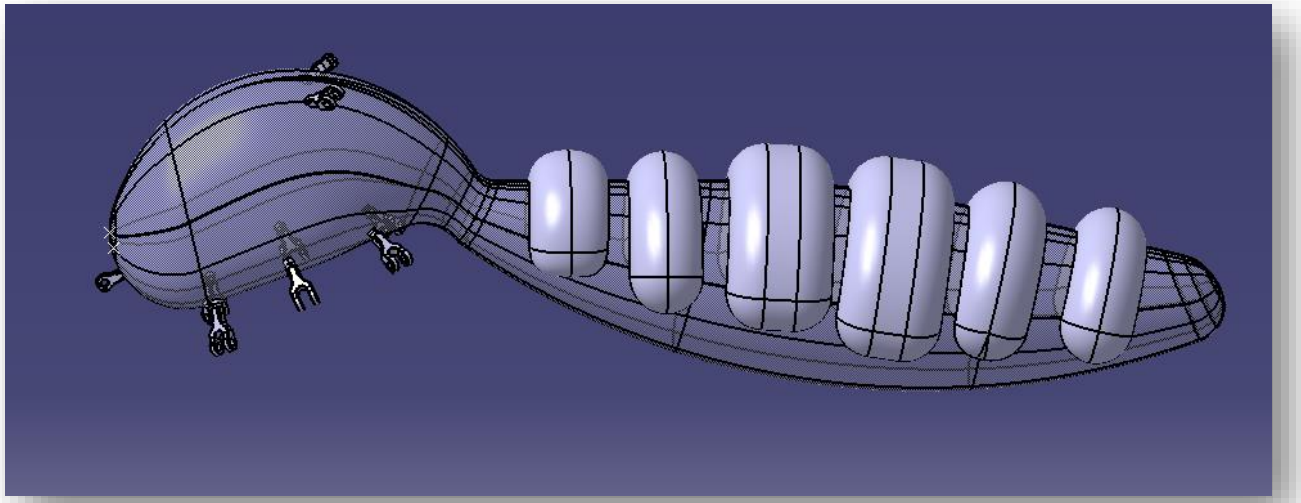


Pump 는 2개의 Sketch와 2개의 Pad로 구현

-> DMU Kinematics에서 Piston처럼 움직이도록 구현

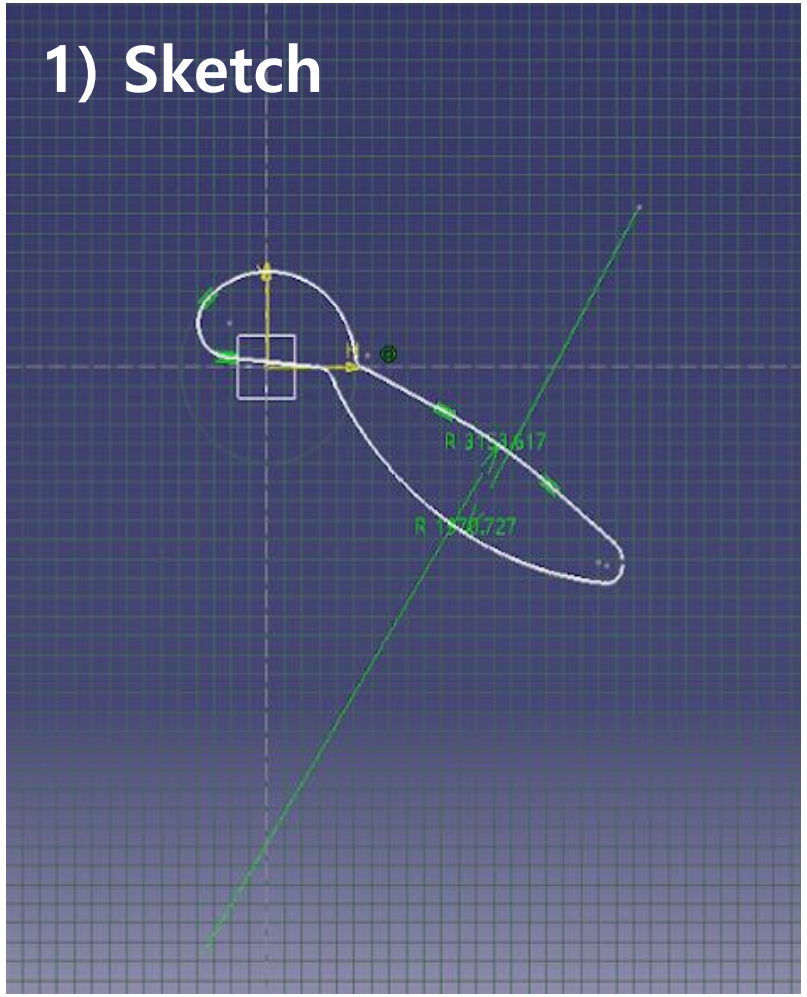




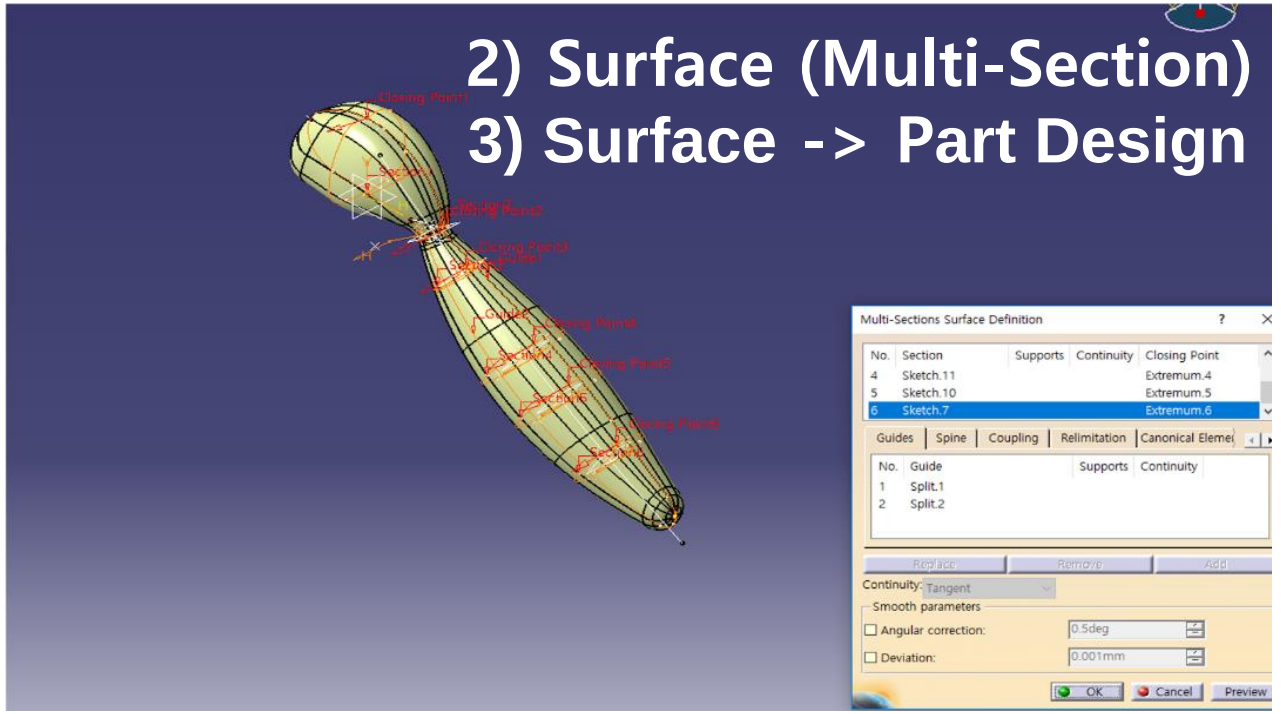


Body & Wing Part

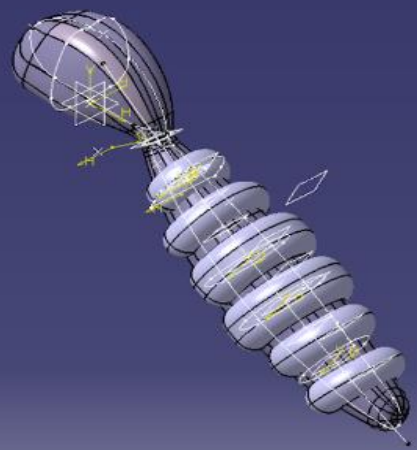
1) Sketch



2) Surface (Multi-Section)
3) Surface -> Part Design

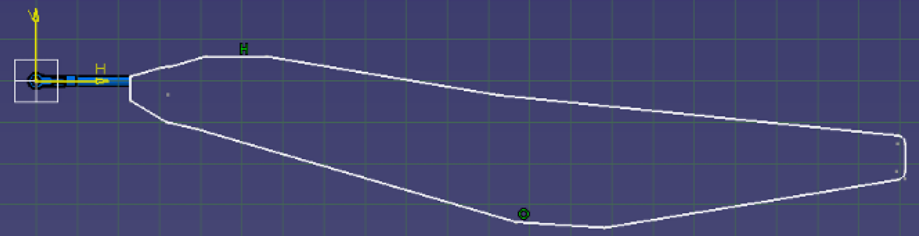


4) Back Shape (pad, edge fillet)

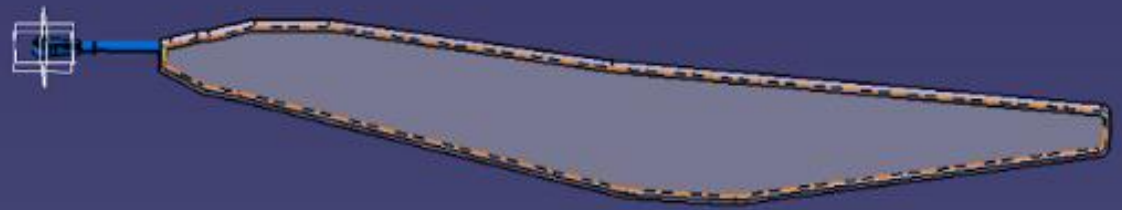


02 Part Design - Wing

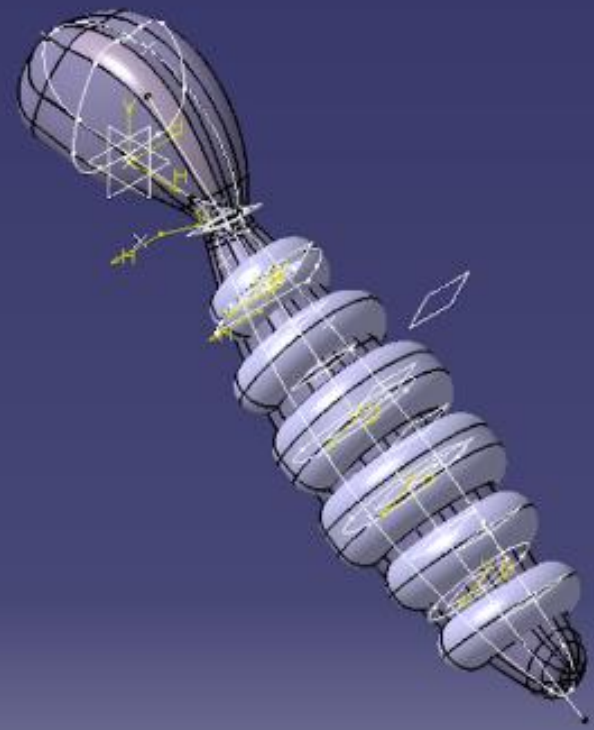
1) Sketch

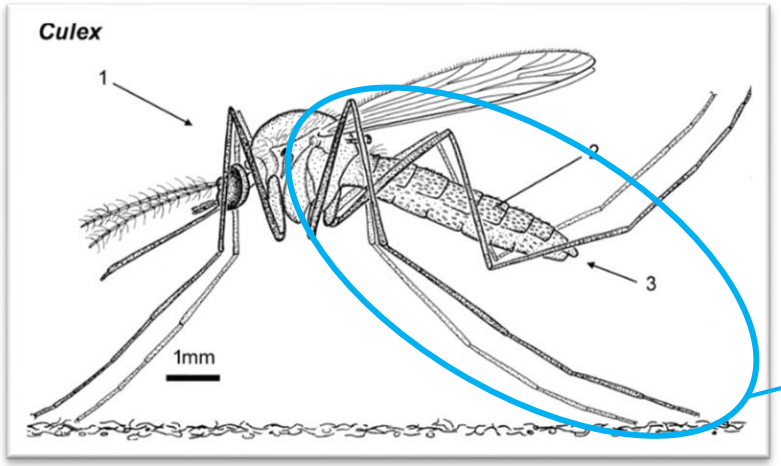


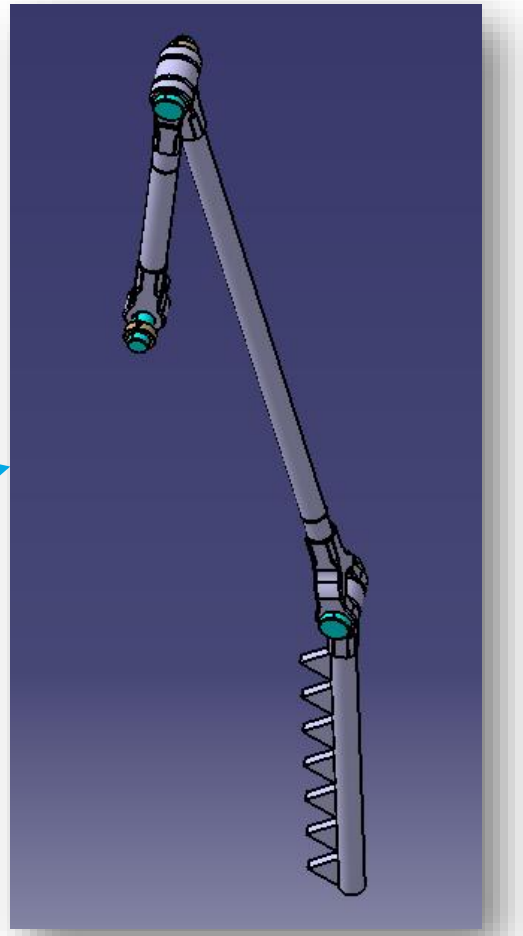
2) Pad



3) Shell



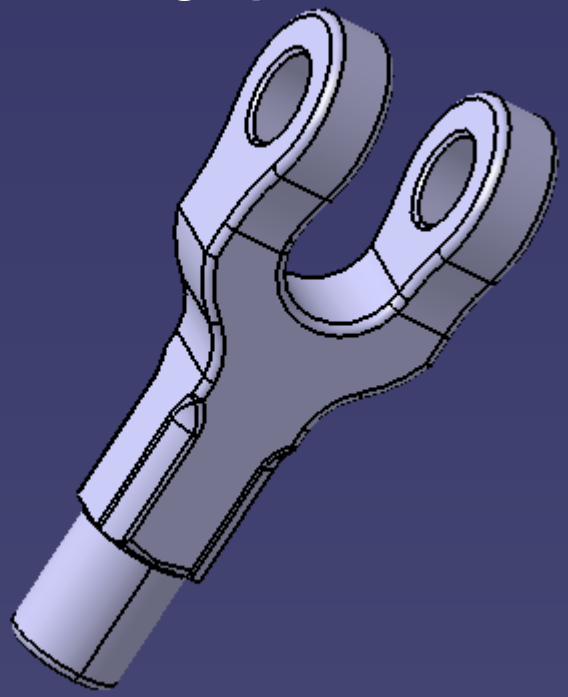




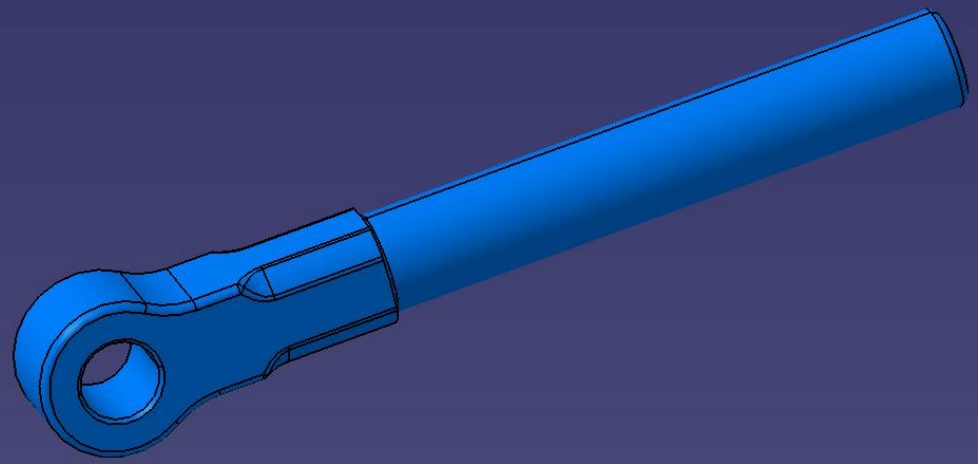
Leg Part

02 Part Design - Leg

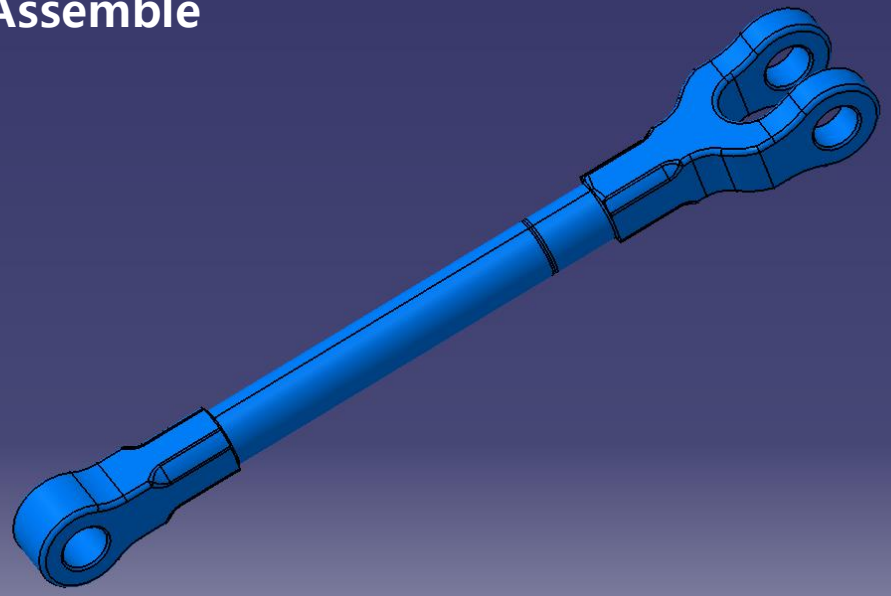
1) Outsource design pattern



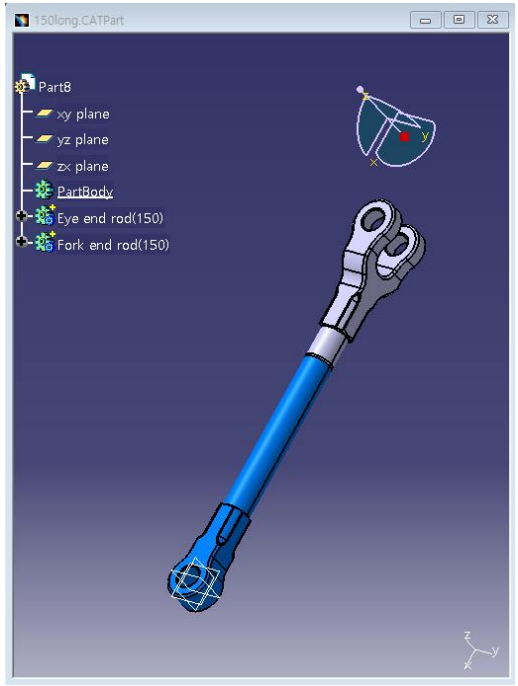
2) Pad & Groove

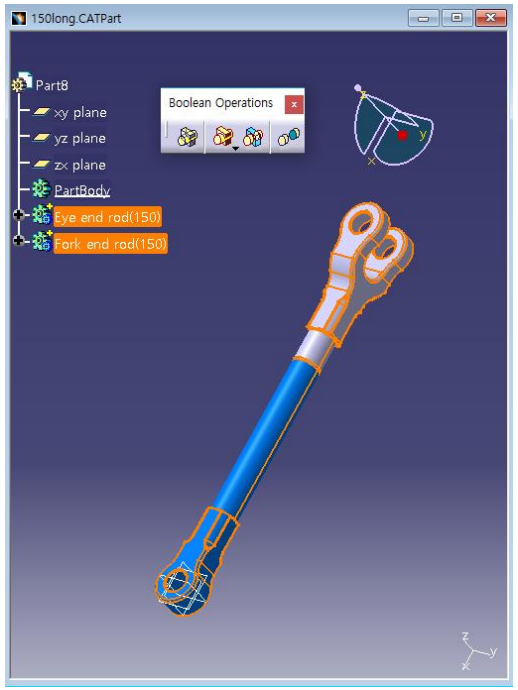


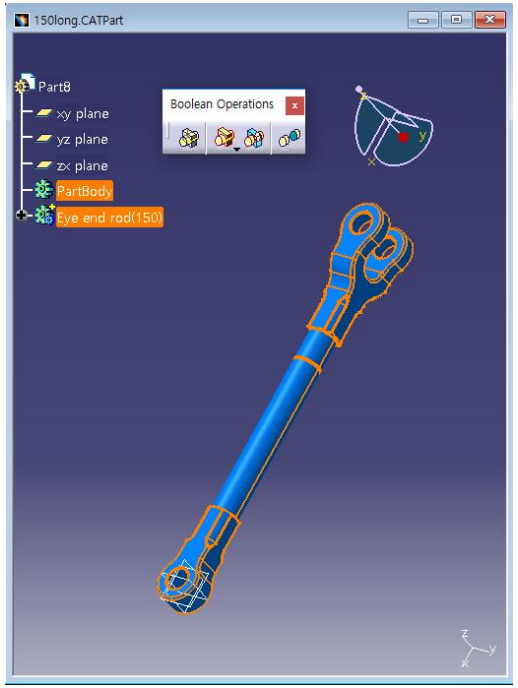
3) Assemble

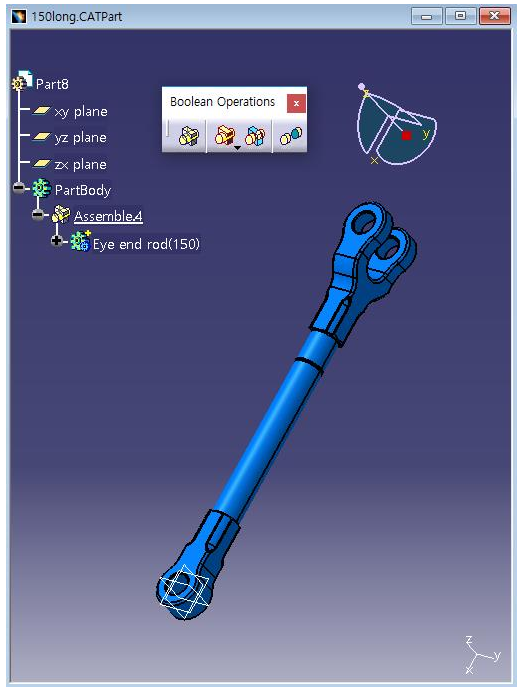


02 Part Design - Leg





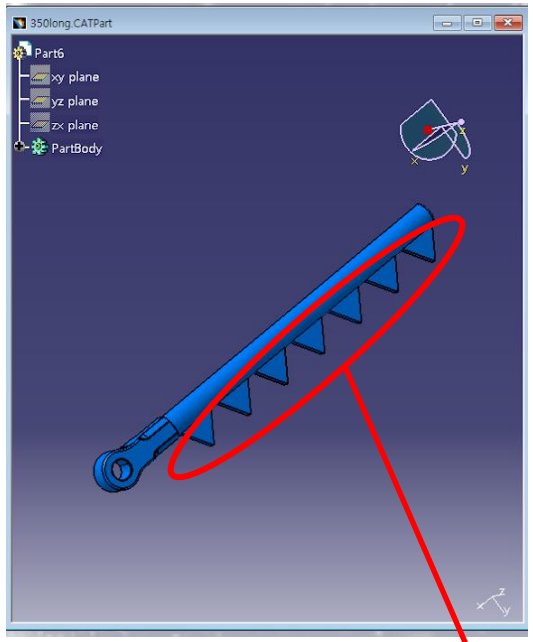




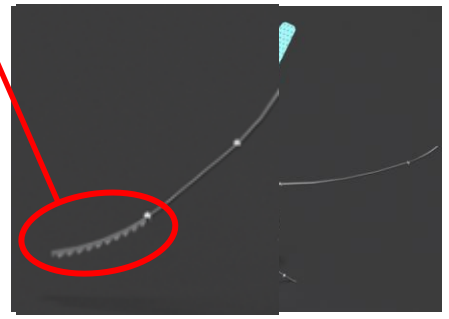
Use Boolean Operations (Add)

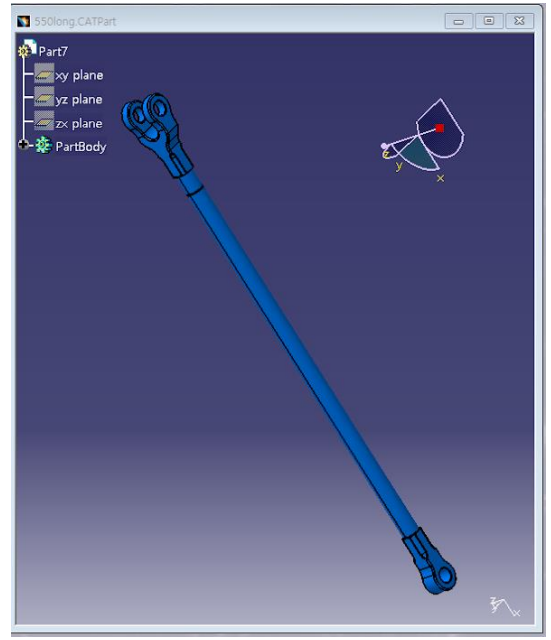
Design 3 kinds of legs for Assemble

150



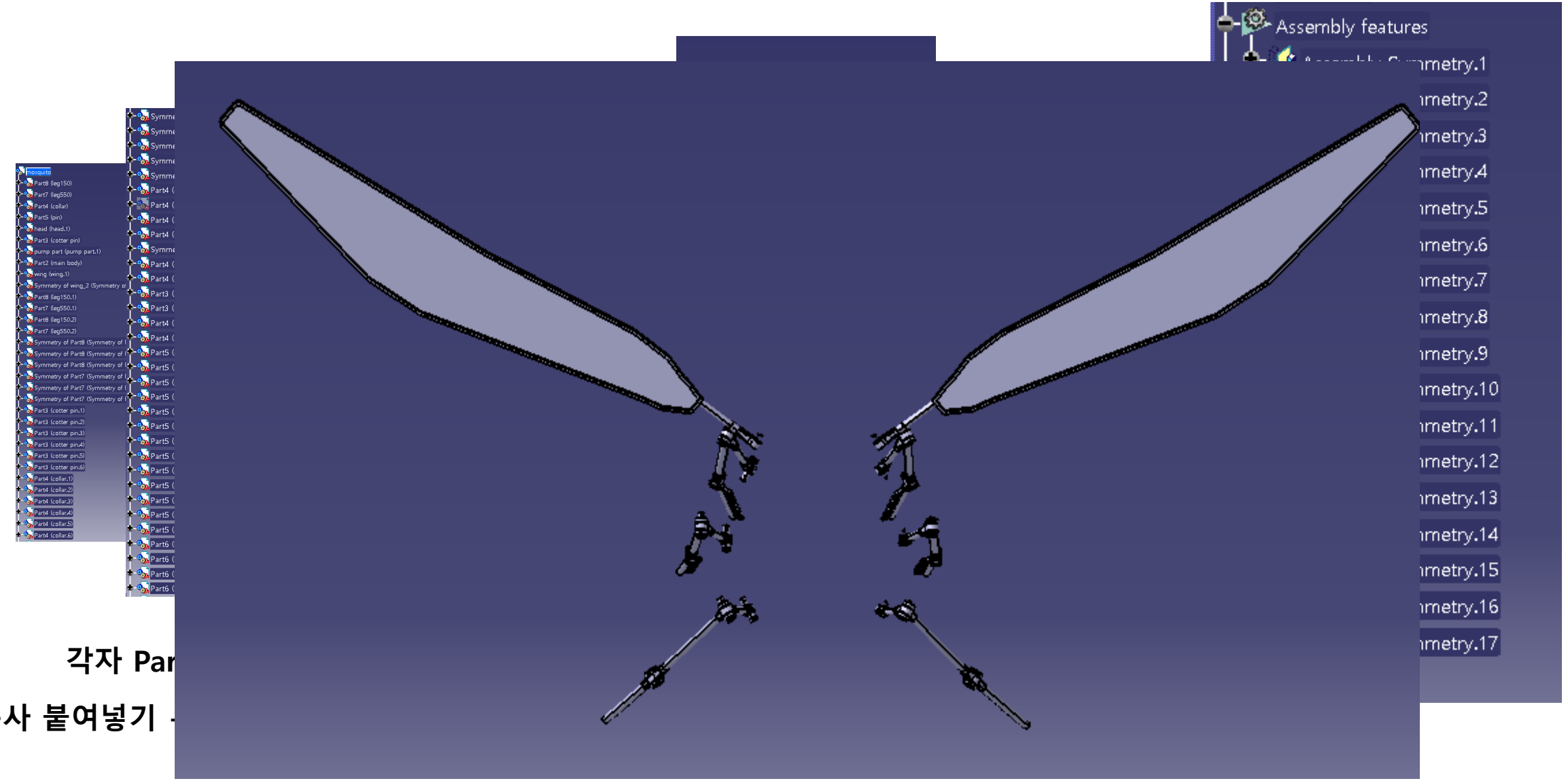
350





550

02 Assembly Design

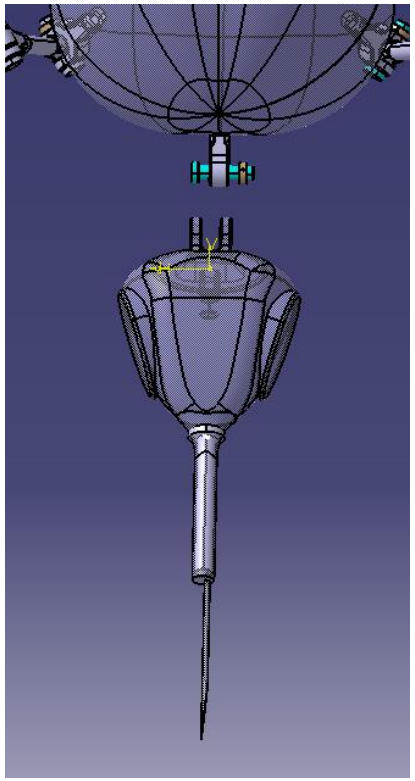


각자 Par

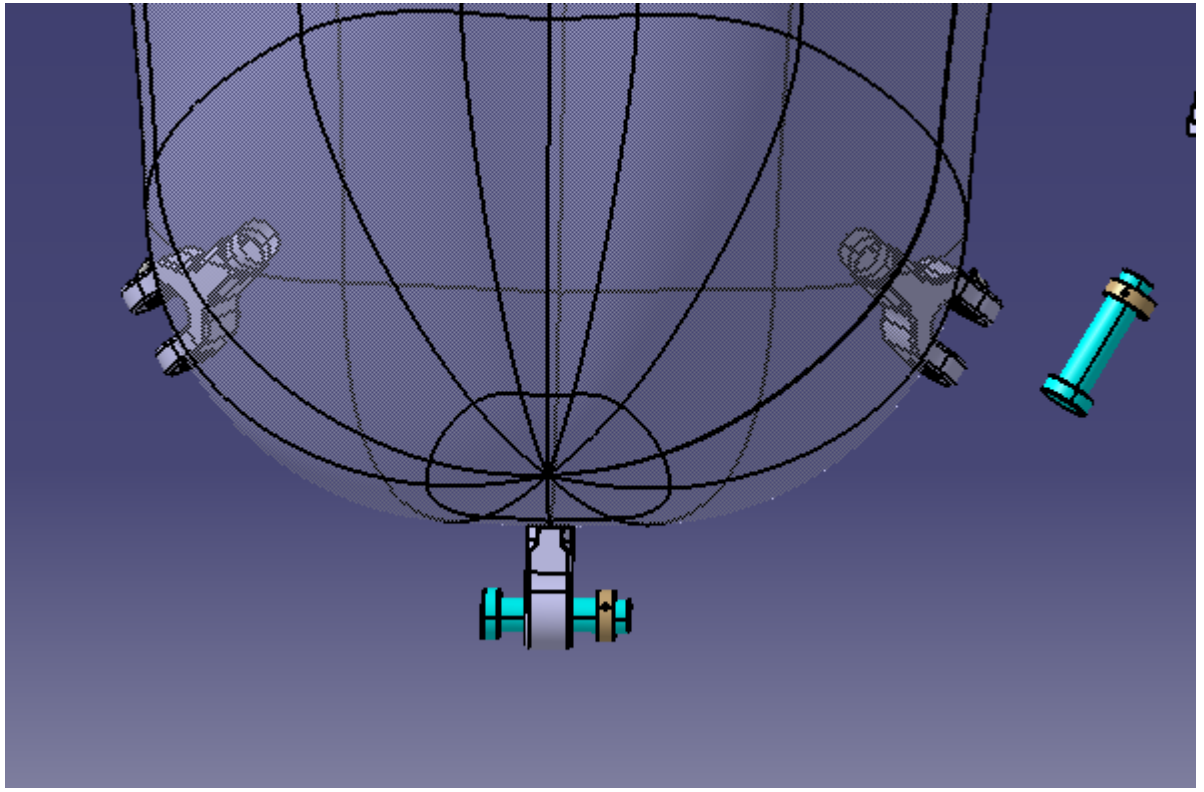
복사 붙여넣기 -

Symmetry 작업 진행

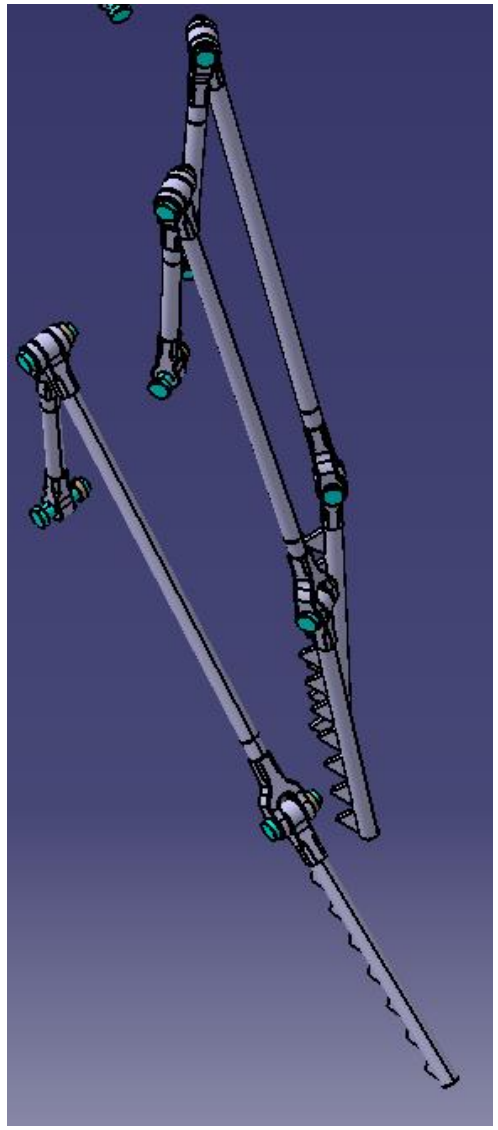
Divide into 3 parts



머리와 몸통 결합부

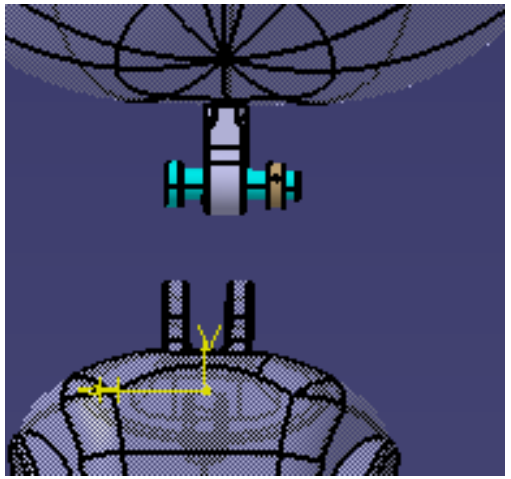


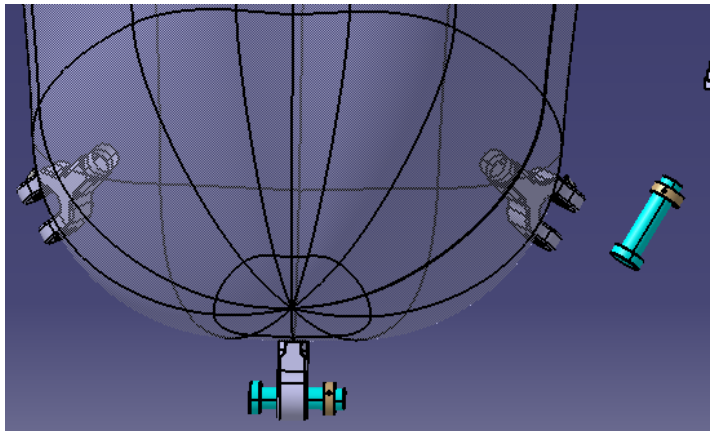
몸통과 다리 결합부

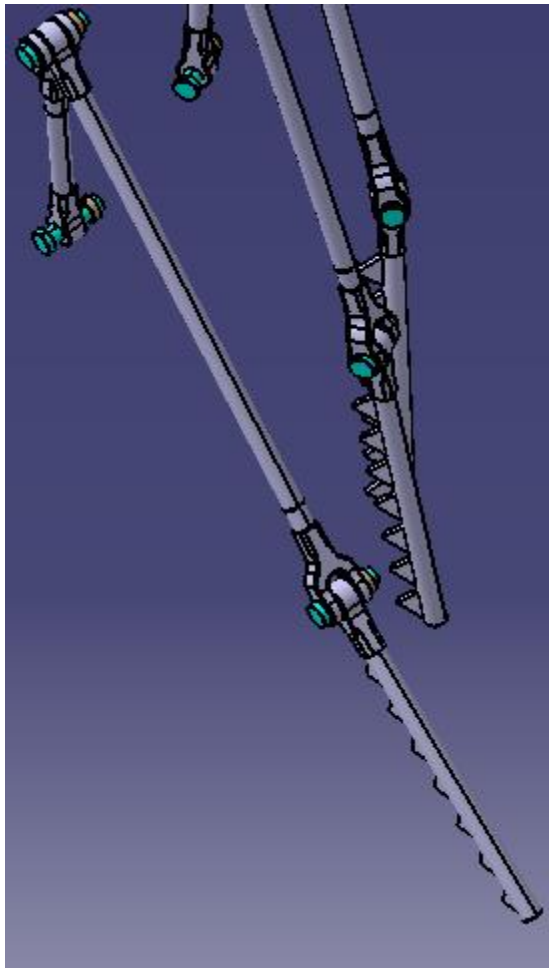


다리

02 Assembly Design



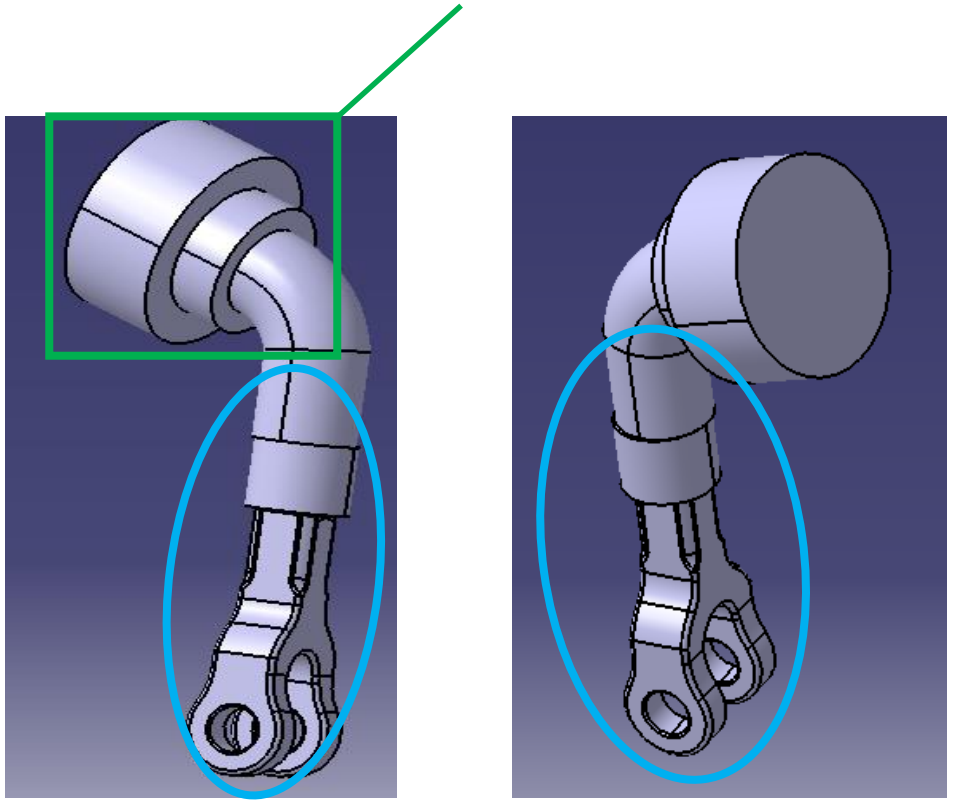




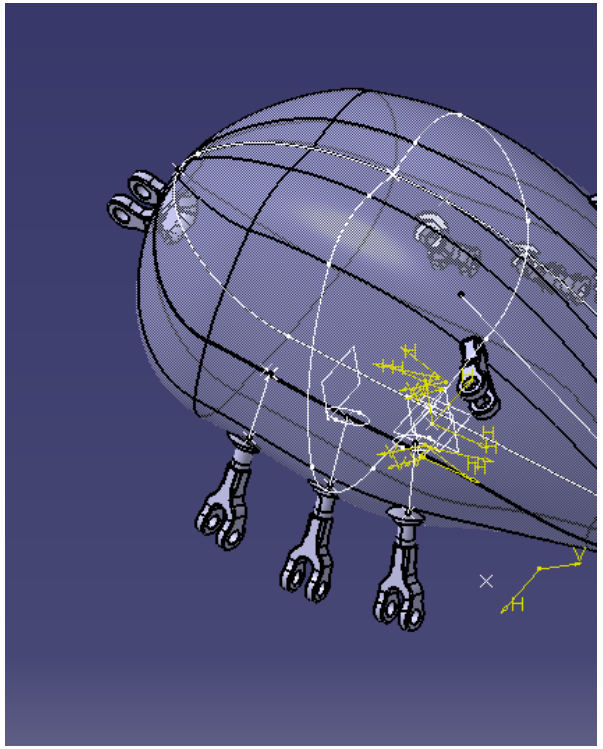
Outsourcing한 Joint 부품과 몸통(GSD) 결합을 위해 part design의 기능 중 하나인 Close Surface 진행

-> 이후 Boolean Operation 진행

결합부 – 원주에 맞게 디자인



관절처럼 구성 후
반복적으로 관절 부분에 적용



Combined with Body

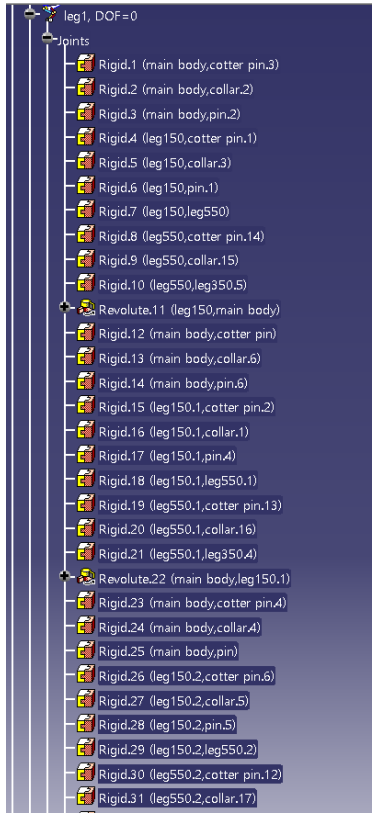
02 Assembly Design

MMR의 Assembly Design에서 Constraint 중

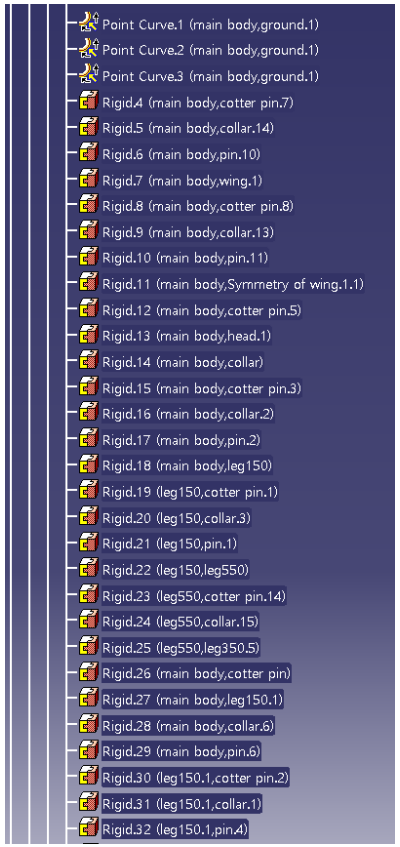
축 일치하는 Coincidence Constraints가 많이 걸렸고

면 결합을 위한 Offset Constraints도 많이 이용

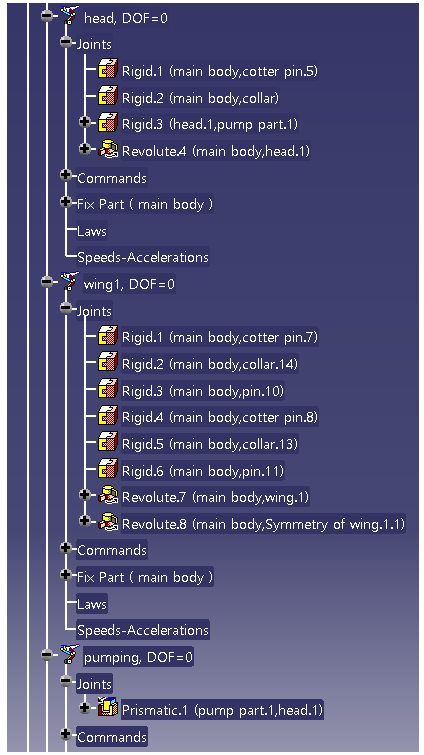
02 DMU KINEMAITCS



Leg Joint

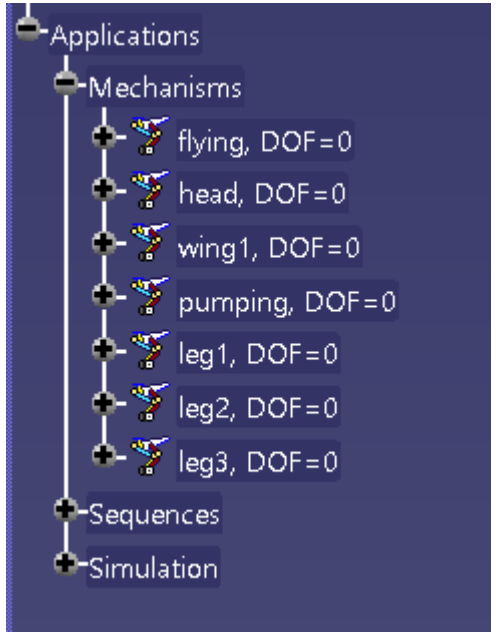


Flying Joint



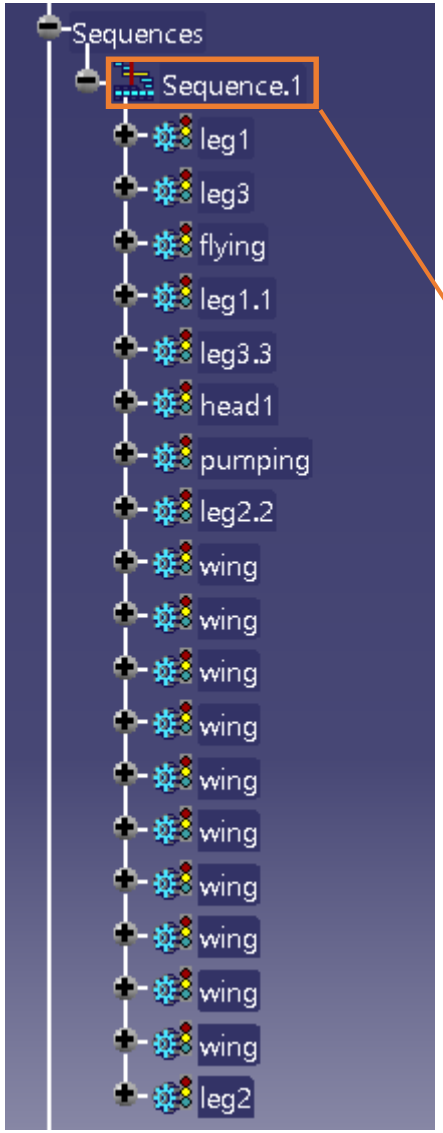
Other Joints

Use Rigid & Revolute Joints



Created Mechanisms

Simulations



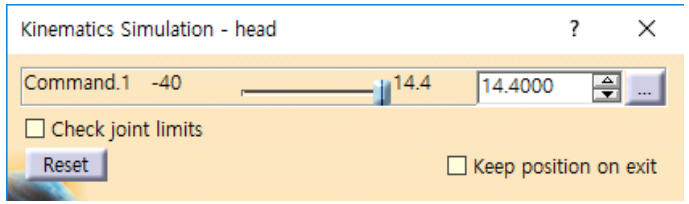
Use Sequence

Leg1 -> Body
Leg2 -> Upper Side
Leg3 -> Foot

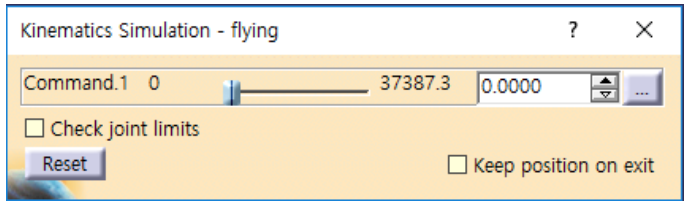
+ Sequence 기능 사용

-> Delay를 줘서
모기 로봇이 자연스럽게
움직일 수 있도록 구현

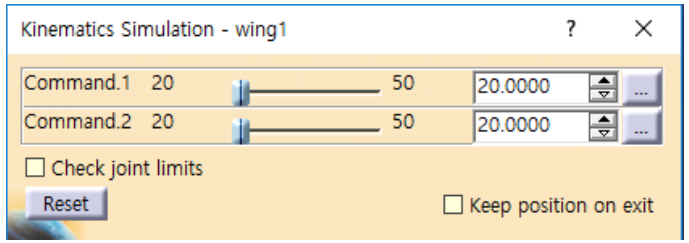
02 DMU KINEMAITCS



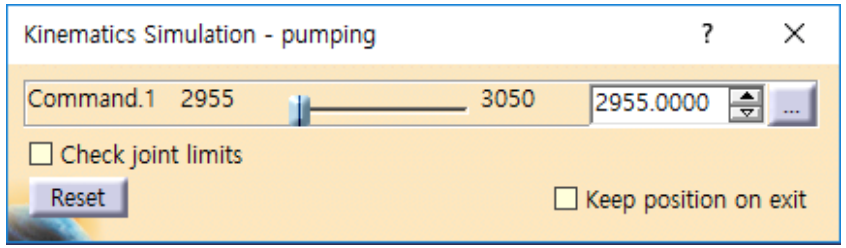
head 각도 조정



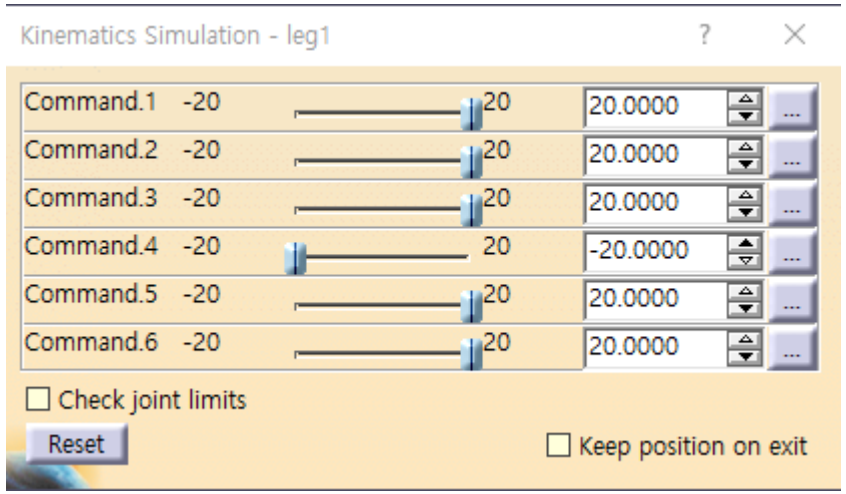
Flying Control



Wing Control

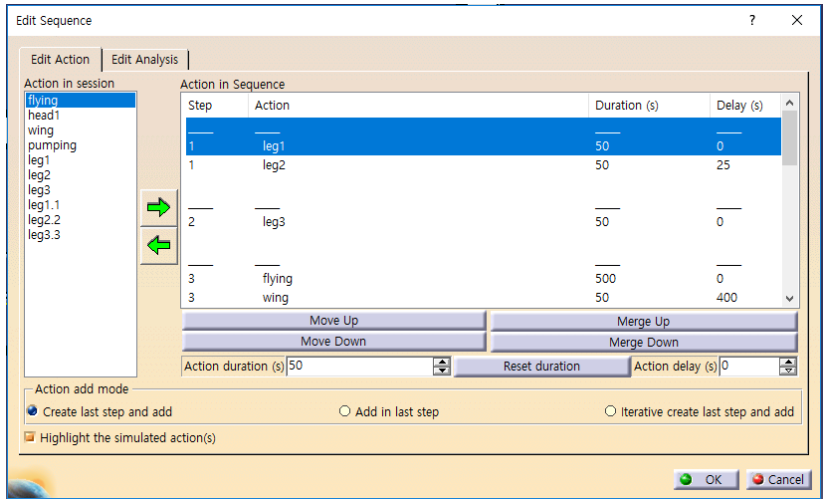


Pump Control



Flying Action 진행시
Leg가 어떻게 변할지 생각하여 Simulation 부여

02 DMU KINEMAITCS



Sequence List

Step	Action	Duration (s)	Delay (s)
3	wing	50	450
3	wing	50	0
3	wing	50	100
3	wing	50	150
3	wing	50	200
3	wing	50	250
3	wing	50	300
3	wing	50	350
3	wing	50	50

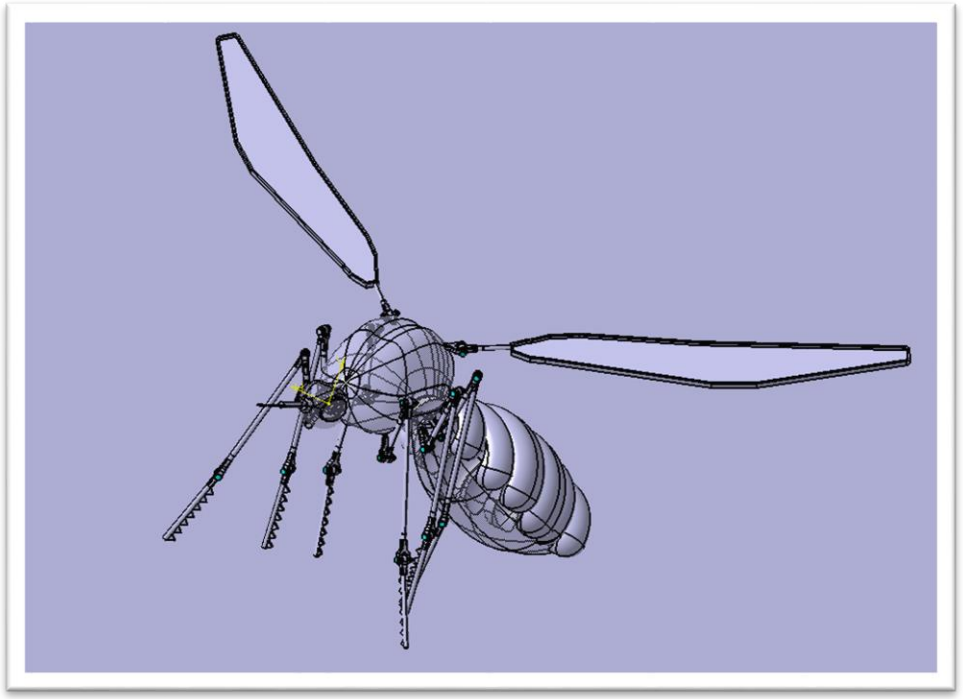
Step	Action	Duration (s)	Delay (s)
4	leg1.1	50	0
4	leg2.2	50	25
5	leg3.3	50	0
6	head1	50	0
7	pumping	100	200

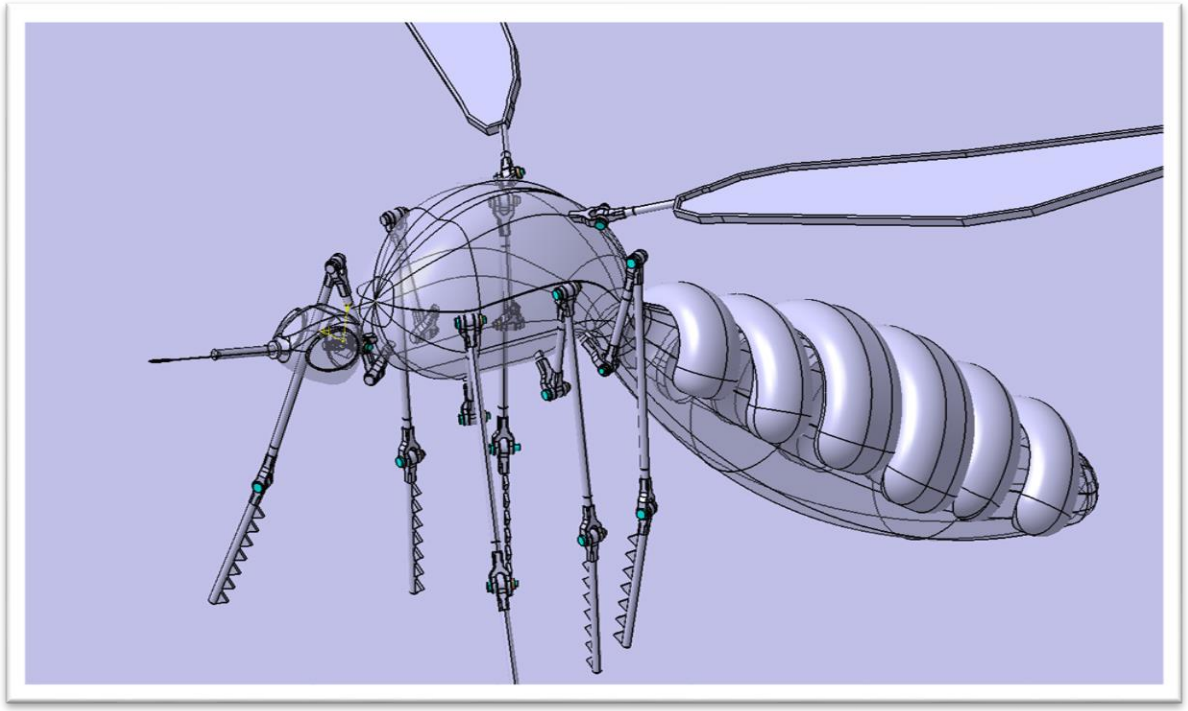
Delays to show natural movement

Computer Aided Design

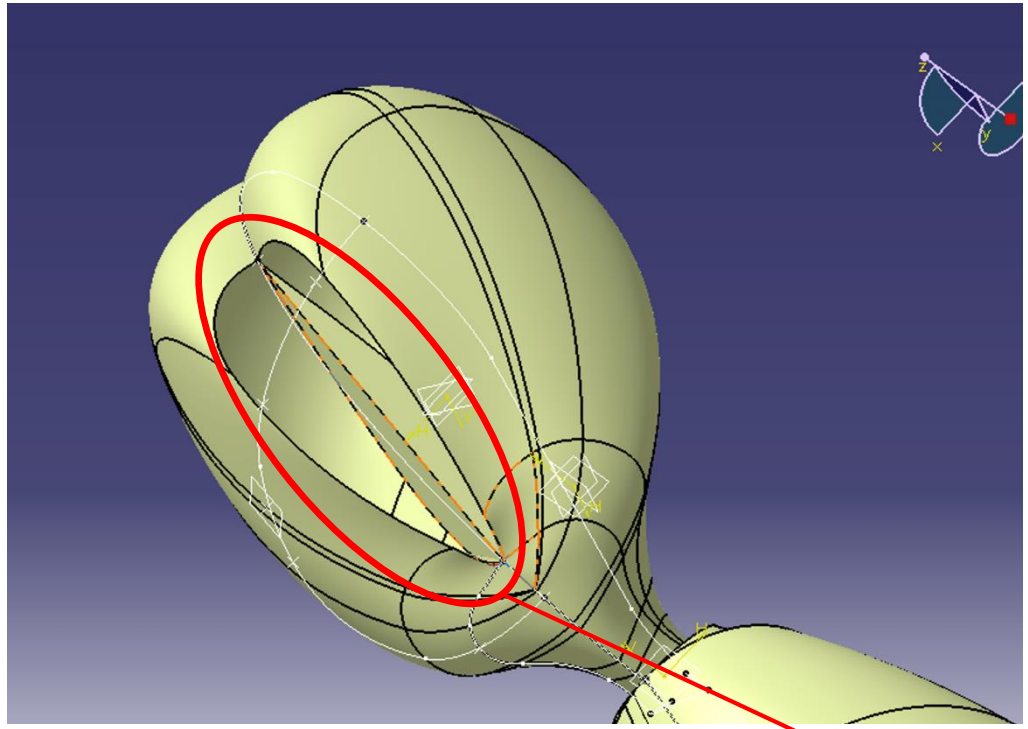
Part 3

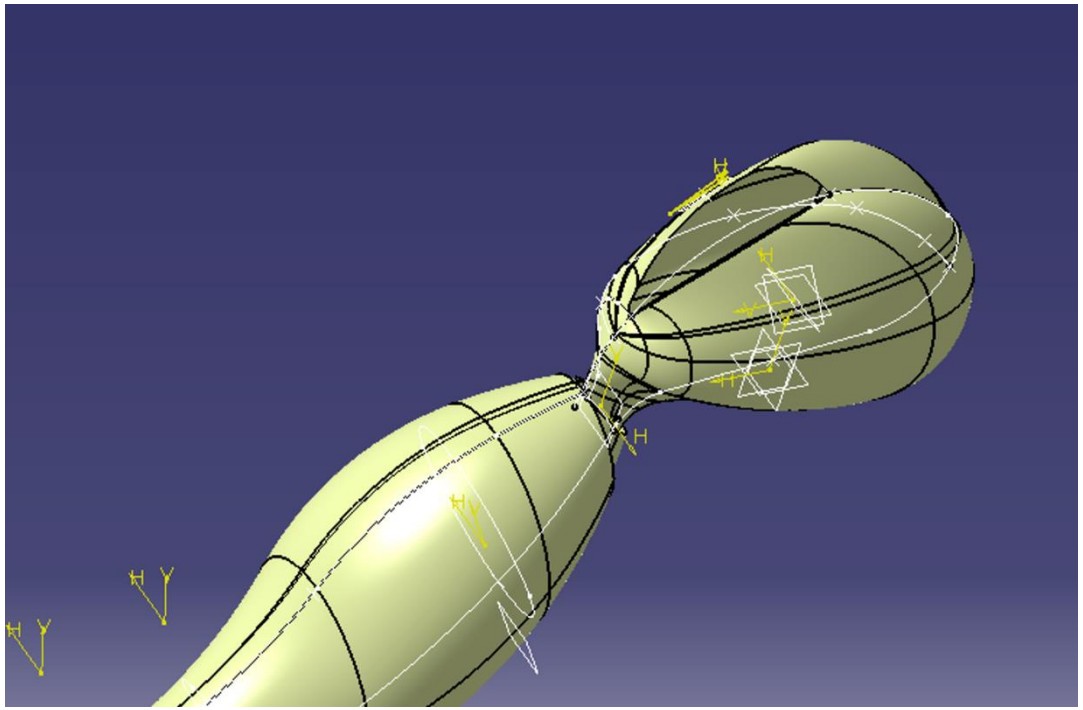
Result & Difficulty





Moving Microscopic Mosquito Robot





Part Design에서 처음에 몸통을 두 부분으로 나눠서 제작

-> Trim 기능이 잘 작동하지 않았고, surface표면이 벌어지는 문제 발생

이를 해결하기 위해 몸통을 분리 하지 않고 하나의 몸통으로 합침.

> Multi-Surface 이용

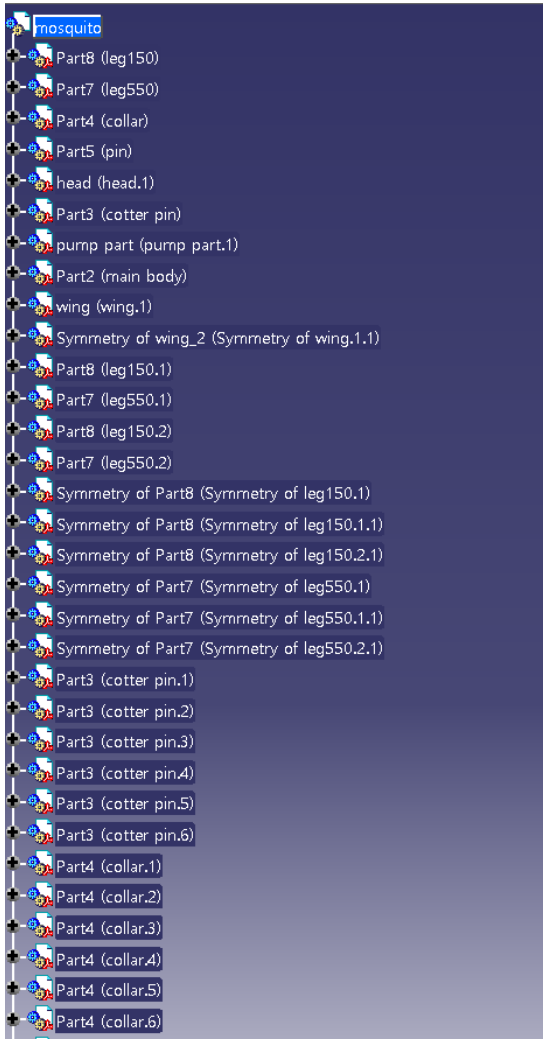
03 DIFFICULTY

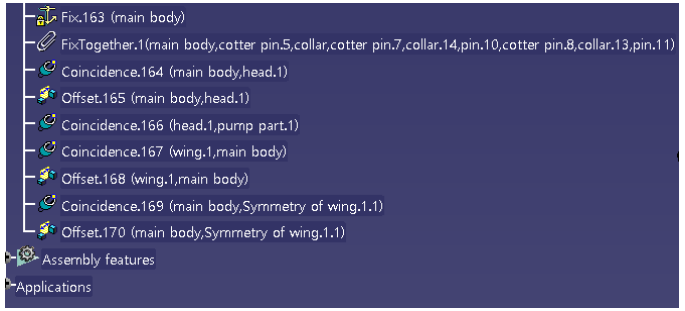
Coincidence 169
Offset 170

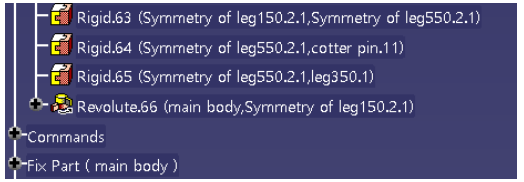
Too many Parts & Constraints & Joints

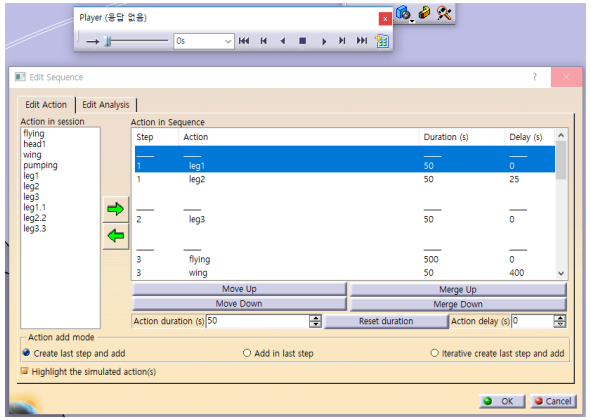
Rigid 65
Revolute 66

03 DIFFICULTY

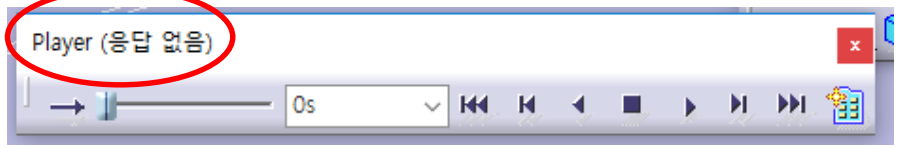








Frequent Error
(No response!!)

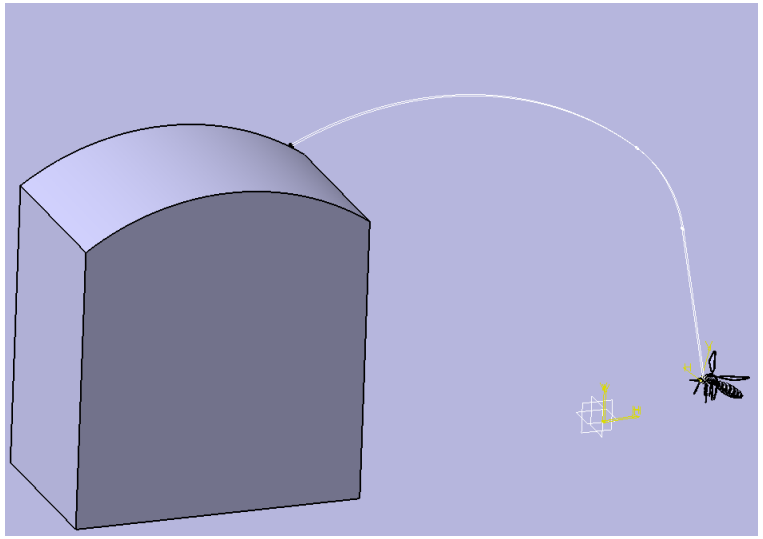


03 DIFFICULTY

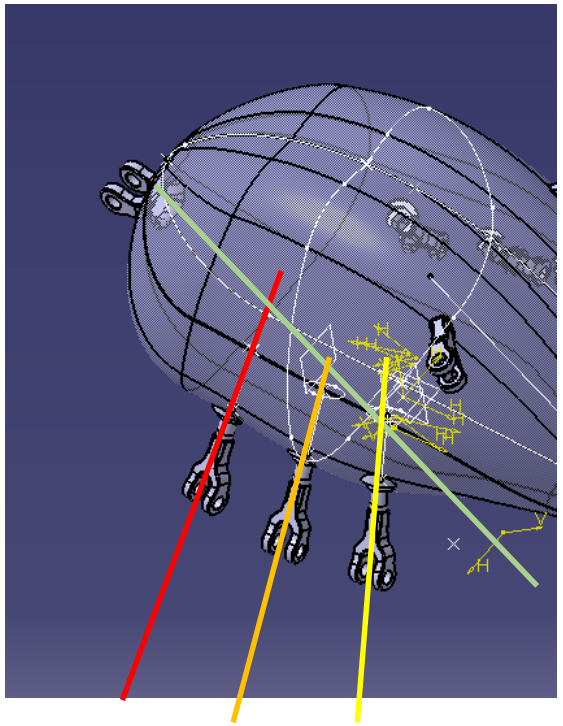
실습 시간에 다뤘던 Part들은 Primitive Type의
3차원 형상들(원, 직사각형 등)로
기준이 되는 축과 평면 설정에 용이

그러나 MMR 모델은
Primitive Type의 형상이 아니라서
쓸 수 있는 Constraint가 제한적

따라서 Point Curve를 사용하여 구현



Point Curve 구현



Leg의 각기 다른 축들과
Body를 관통하는 축

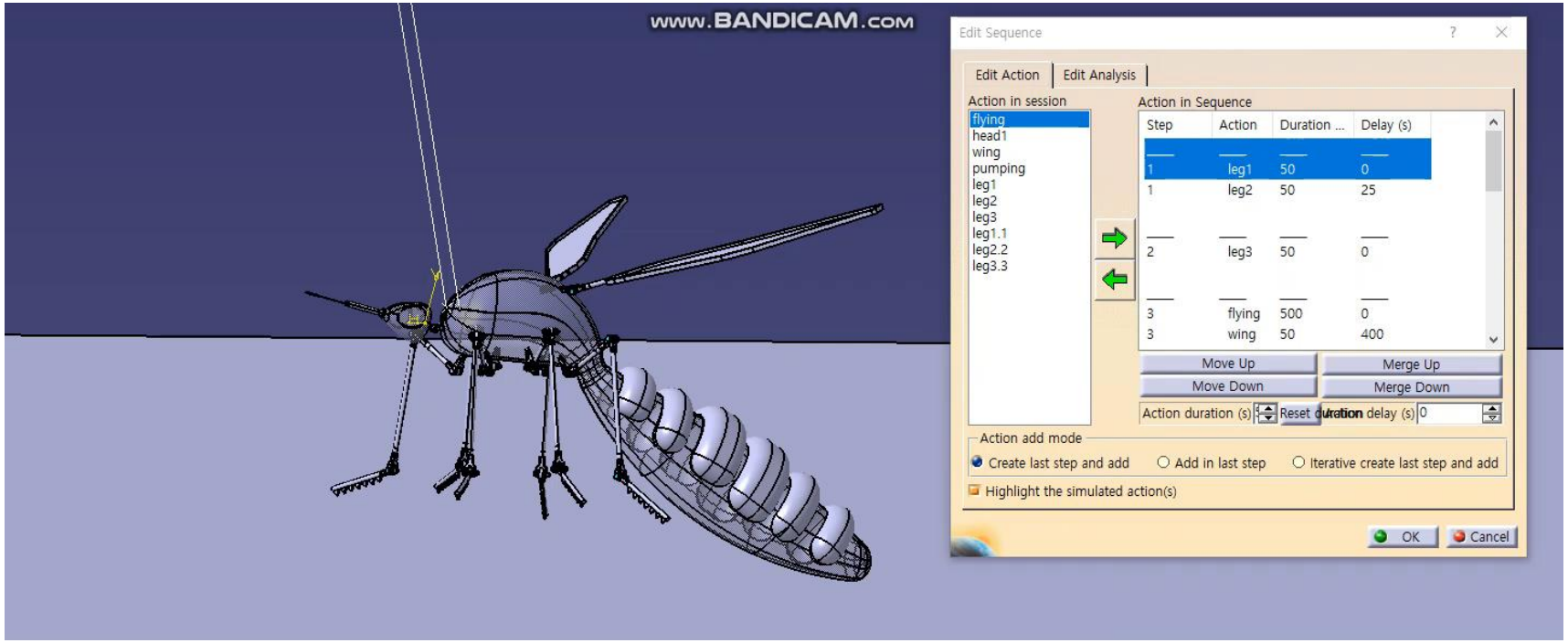
Computer Aided Design

Part 4

Video + Q & A

03 RESULT Video

Mosquito Robot DMU 구현 영상

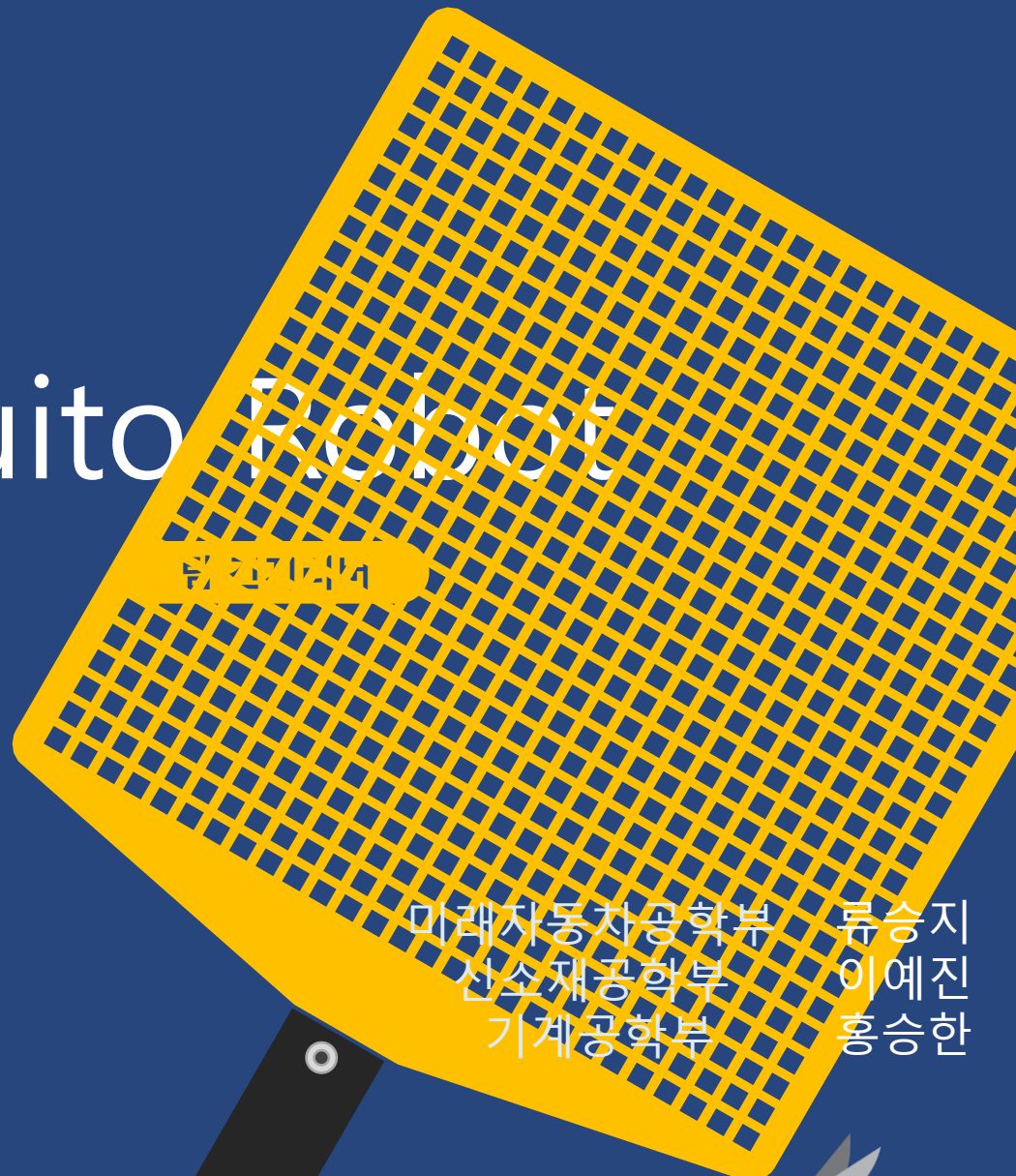


https://www.youtube.com/watch?v=n5EEEV6QbEg

Q & A

Microscopic Mosquito

2022년 1학기 CAD



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기계공학부 홍승한

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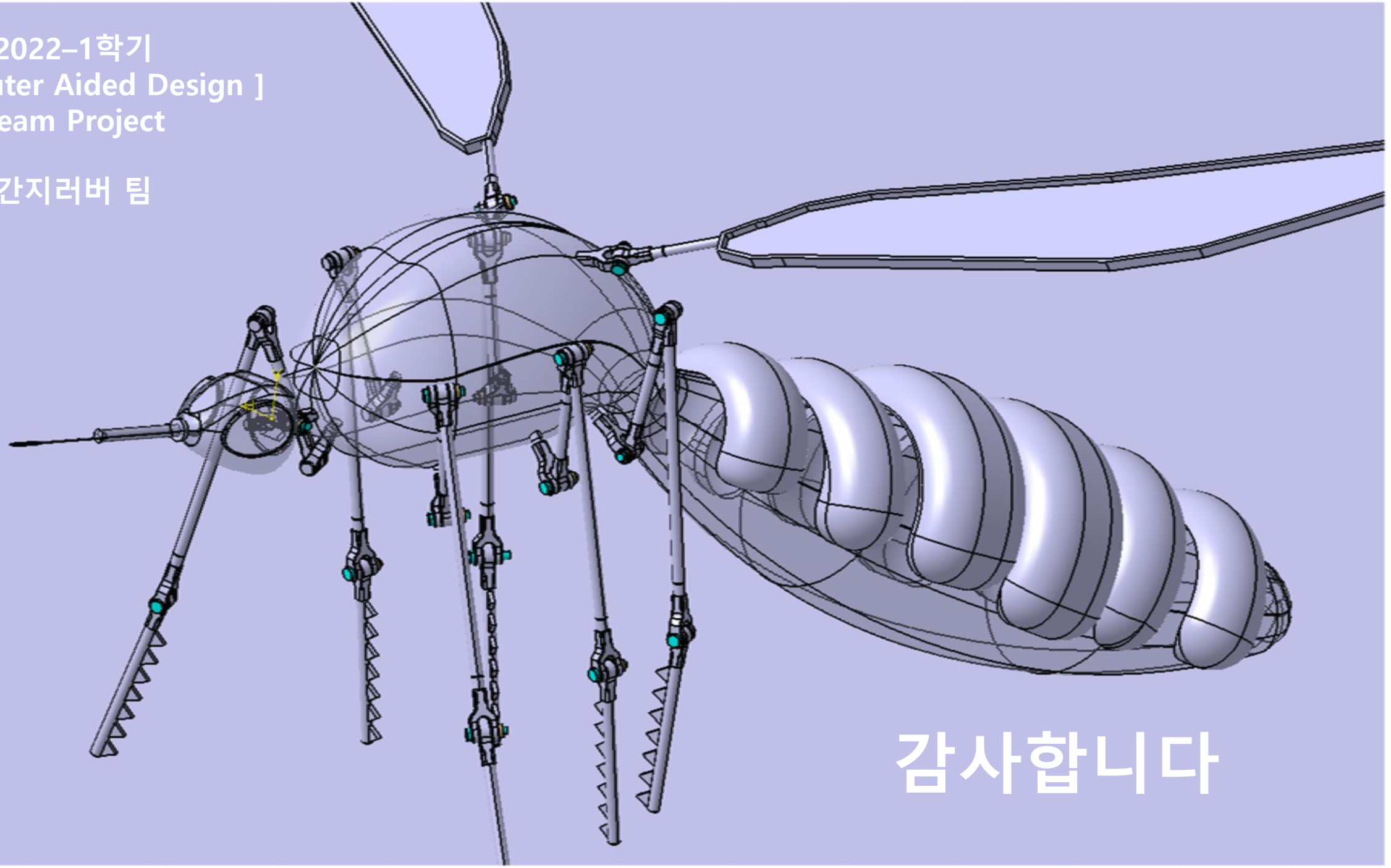
- https://grabcad.com/library/mosquito-killer-robot-created-in-partsolutions-1
- knuckle joint | 3D CAD Model Library | GrabCAD

2022-1학기
[Computer Aided Design]
Team Project

간지러버 팀



감사합니다