DMU KINEMATICS

Computational Design Laboratory
Department of Automotive Engineering
Hanyang University, Seoul, Korea

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CONTENTS

- ✓ 시작하기
- ✓ DMU Kinematics Tools
- ✓ DMU Generic Animation

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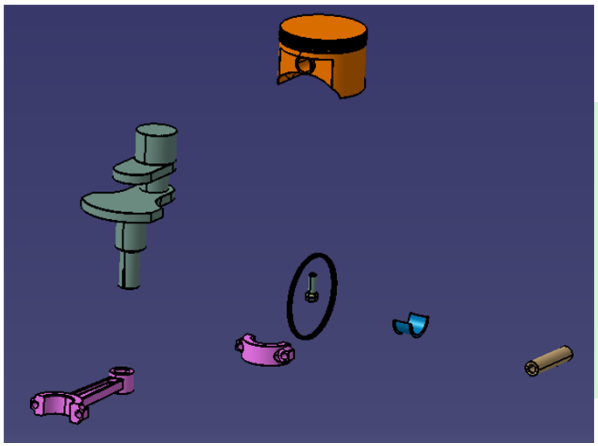
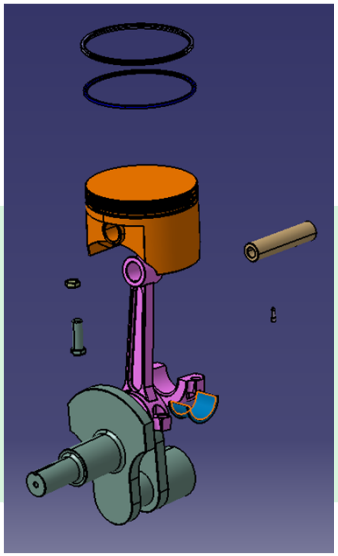
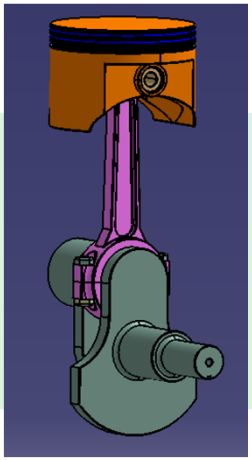
DMU KINEMATICS 진행 순서



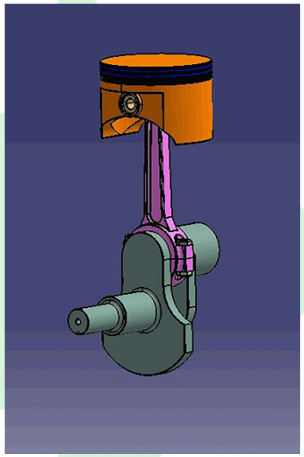
모델 불러오기



대략적 배치/수정



Joint 부여



Joint 생성 후
구동 확인

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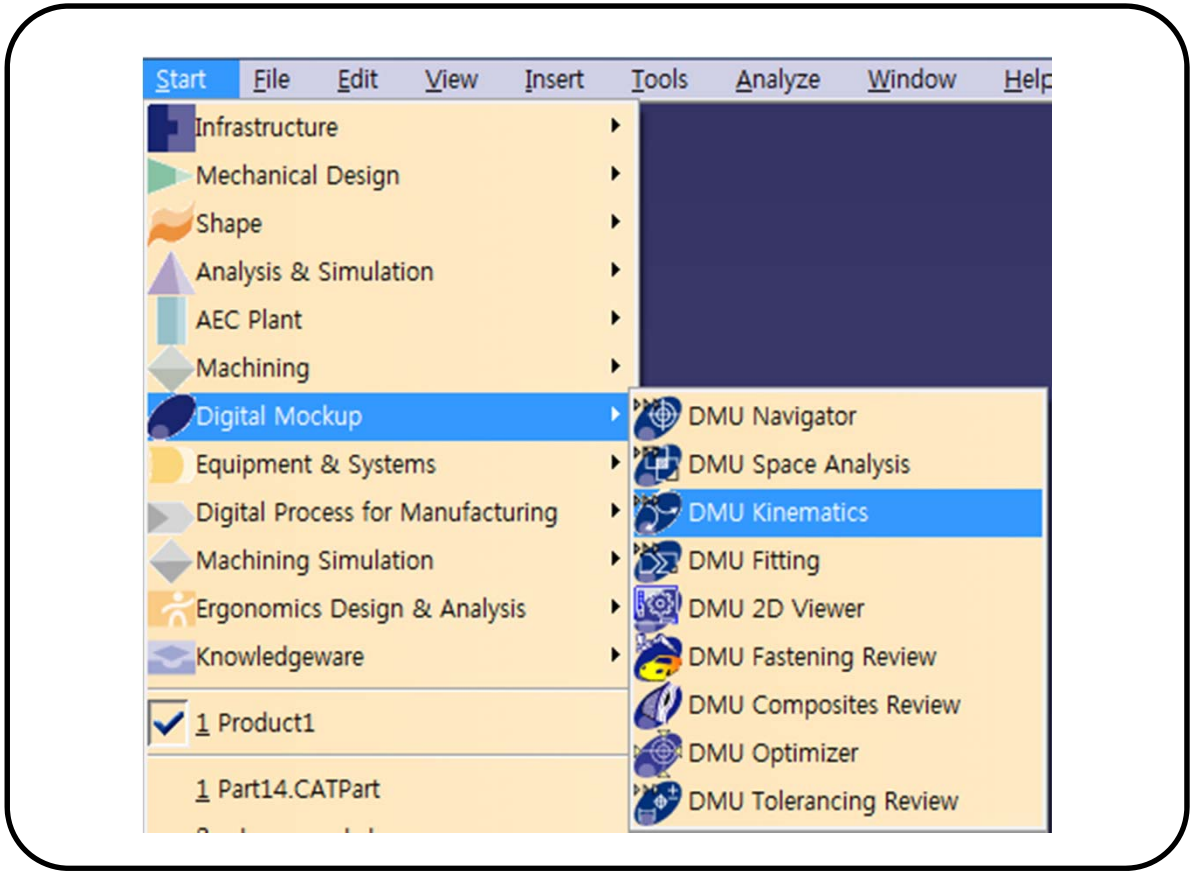
DMU KINEMATICS 시작하기

Start 메뉴에서 Digital Mockup → DMU Kinematics 선택



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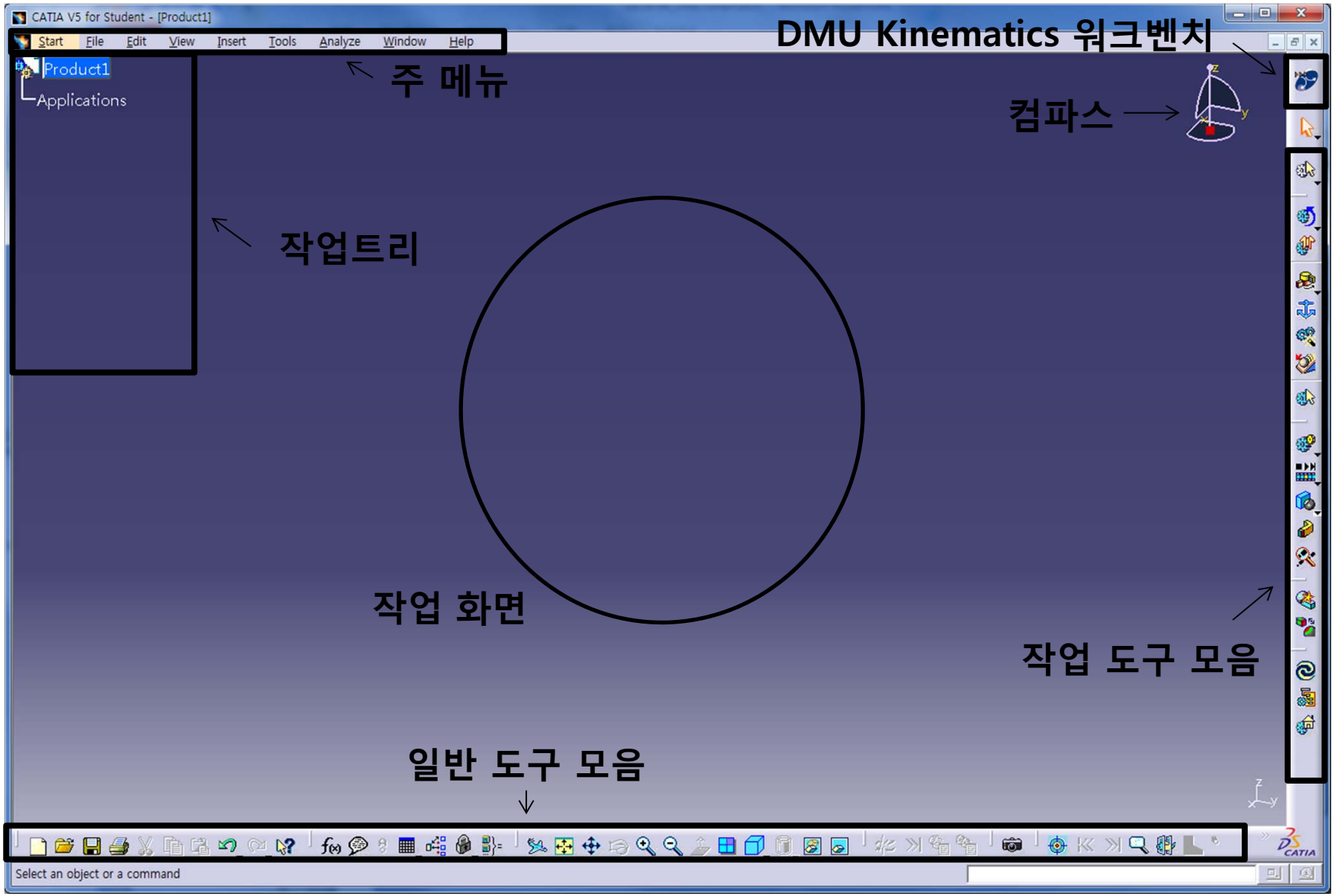
DMU KINEMATICS 작업화면



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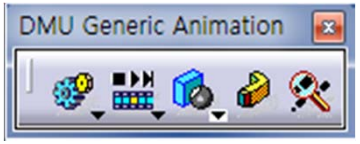
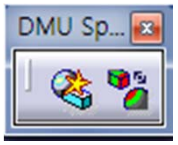
DMU KINEMATICS 툴바 종류

만들어진 Component를 불러들여서 component간에 운동을 부여하거나 구속함.



만들어진 mechanism을 동작함.



Component간에 간섭, 거리를 확인함.

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CONTENTS

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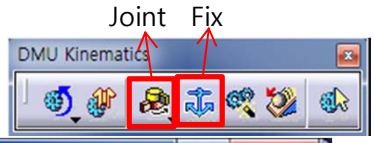
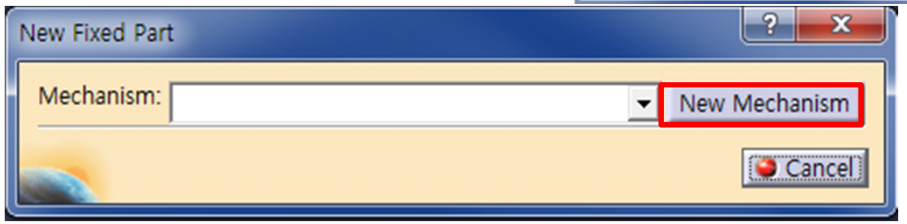
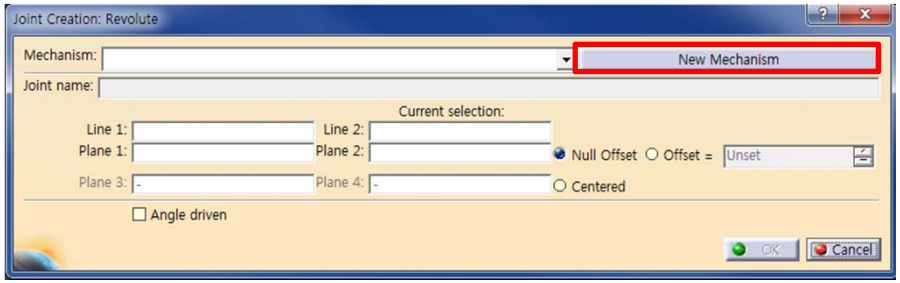
- Mechanisms 메뉴 생성

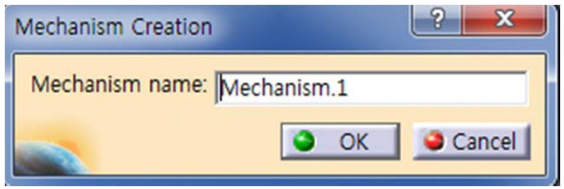
<Fix Part 혹은 Joint 선택>

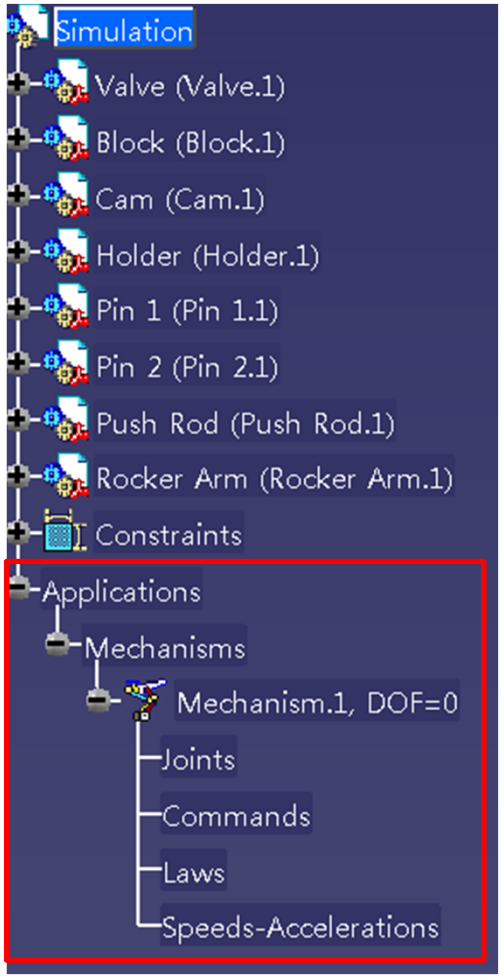




혹은







<Mechanisms 생성>

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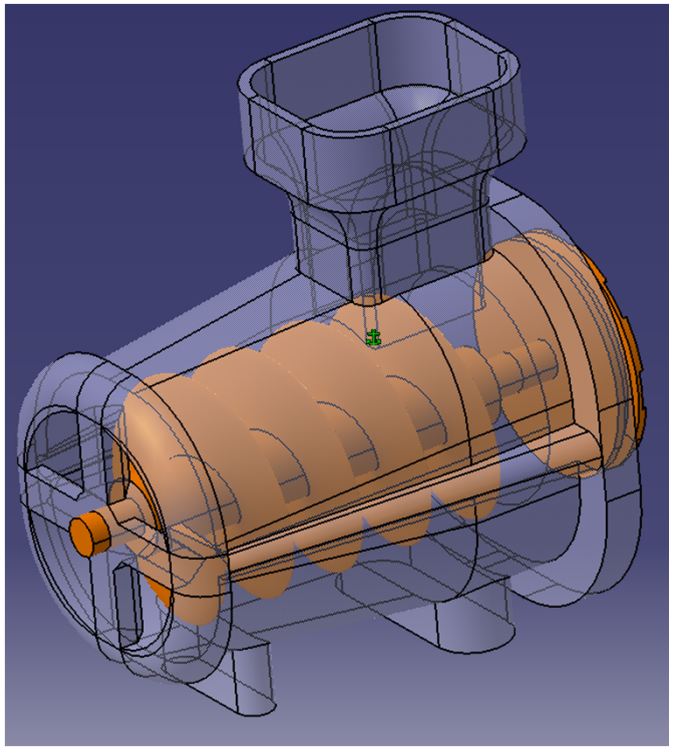
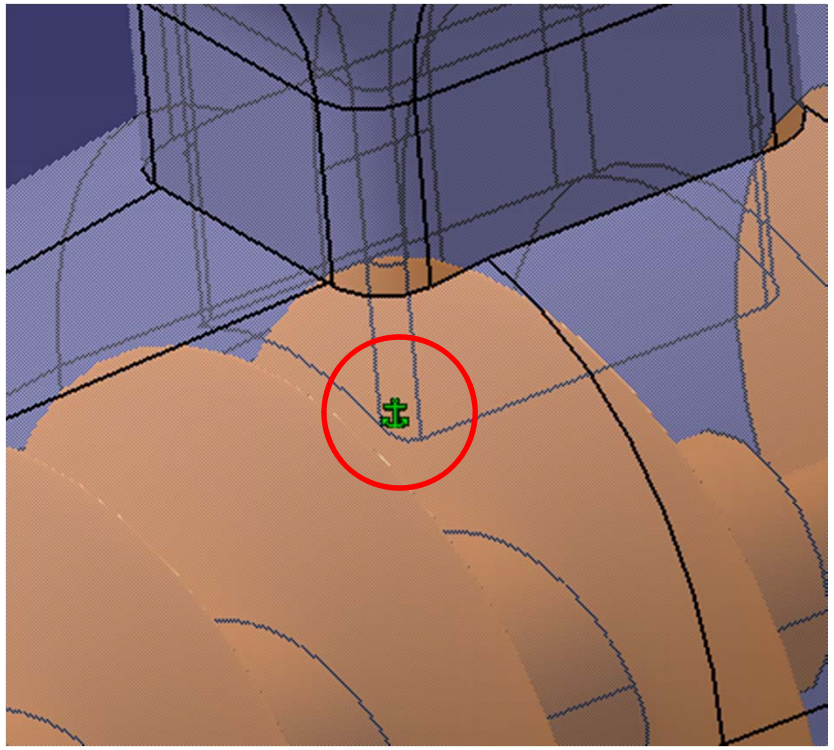
Fixed Part 

- 선택한 Component를 고정 (기준이 되는 하나의 component만 가능)





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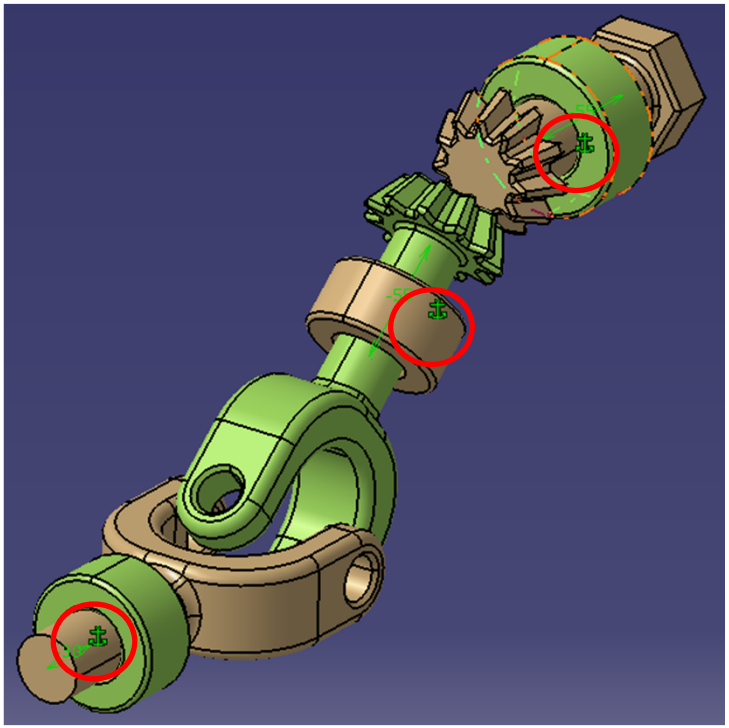
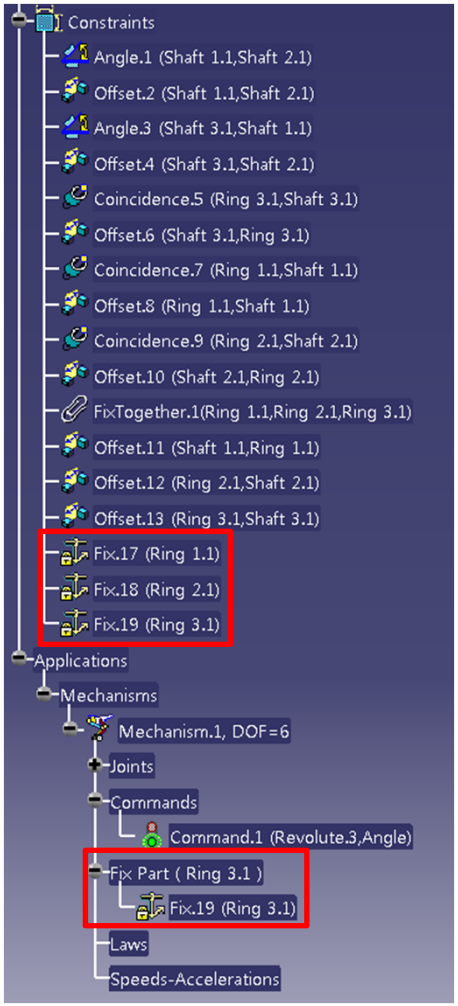
Fixed Part

- 선택한 Component를 고정 (기준이 되는 하나의 component만 가능)



<다수의 Fix를 생성해도 mechanism에는 하나만 생성됨>



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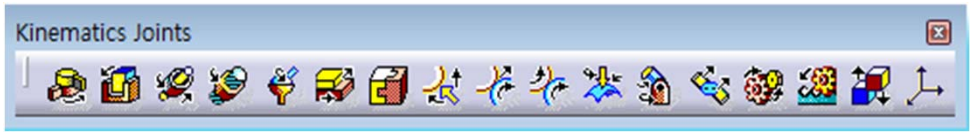

Revolute	: 평면을 기준으로 회전하도록 joint 생성
Prismatic	: 특정 면을 기준으로 병진 운동하도록 joint 생성
Cylindrical	: 병진운동과 회전 운동하도록 joint 생성
Screw	: Pitch 값을 기준으로 회전과 병진 운동하도록 joint 생성
Spherical	: 특정한 point를 중심으로 운동하도록 joint 생성
Planar	: 특정한 plane를 중심으로 운동하도록 joint 생성
Rigid	: component간의 상대위치를 고정시켜주는 joint를 생성
Point Curve	: 특정 점이 특정 곡선을 따라 움직이도록 joint 생성
Slide Curve	: 특정 곡선이 다른 곡선을 따라 움직이도록 joint 생성
Roll Curve	: 특정 곡선끼리 맞물려 움직이도록 joint 생성
Point Surface	: 특정 점이 특정 곡면을 따라 움직이도록 joint 생성
Universal	: 두 축을 연결해주기 위한 joint 생성
CV	: 3개의 축을 연결해 주기 위한 joint 생성
Gear	: 기어 비를 이용하여 두 개의 prismatic joint를 연결함
Rack	: 기어 비를 이용하여 prismatic joint와 revolute joint를 연결함
Cable	: Cable이 연결 된 것처럼 움직이도록 joint 생성
Axis-based	: Component의 Axis를 기준으로 joint 생성

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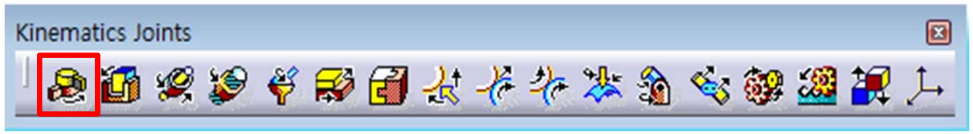
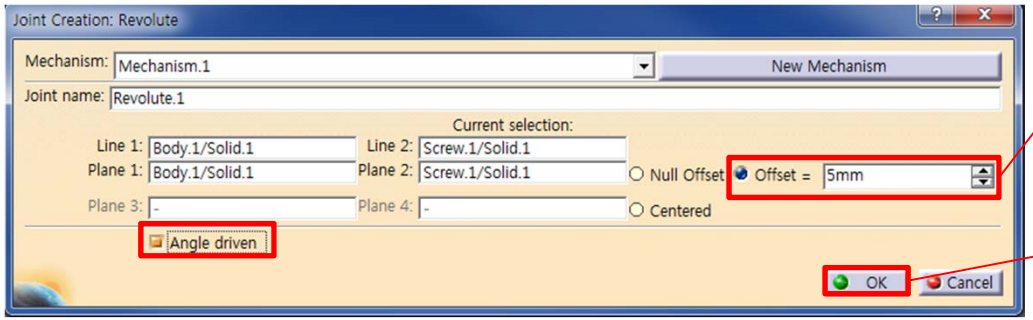


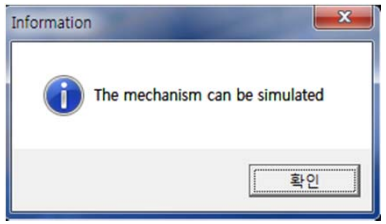
Revolute Joint 

- 두 component가 평면을 기준으로 회전하도록 joint 생성

<Line, Plane 선택>



Offset 선택 시, 선택한 plane 사이의 거리가 자동으로 입력됨



Mechanism이 실행 가능한 경우

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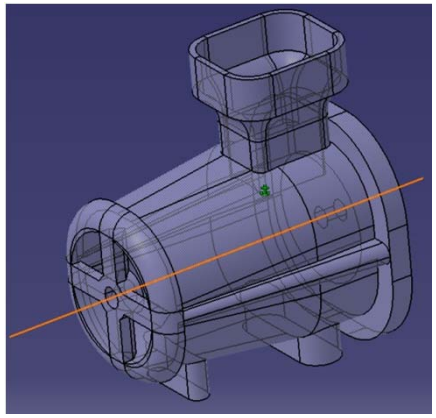
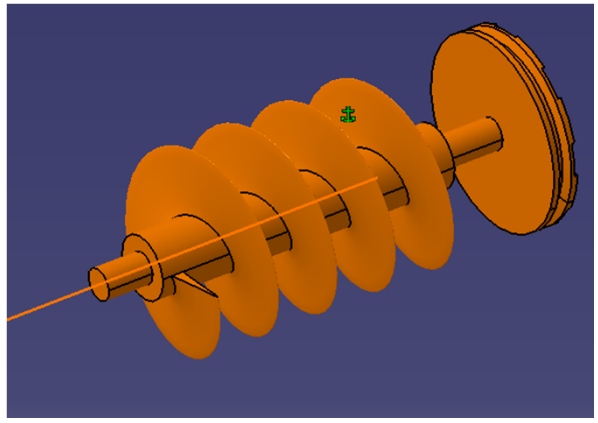
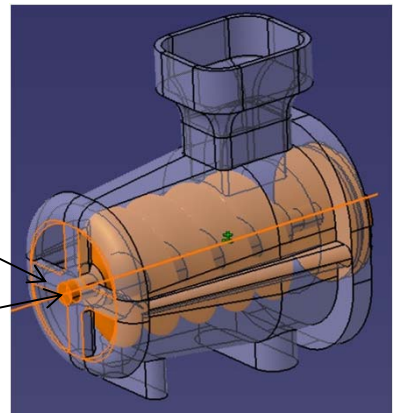


<Line 2>



<Plane>



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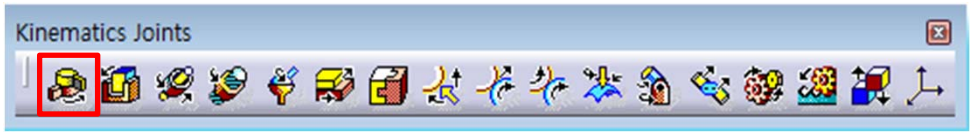
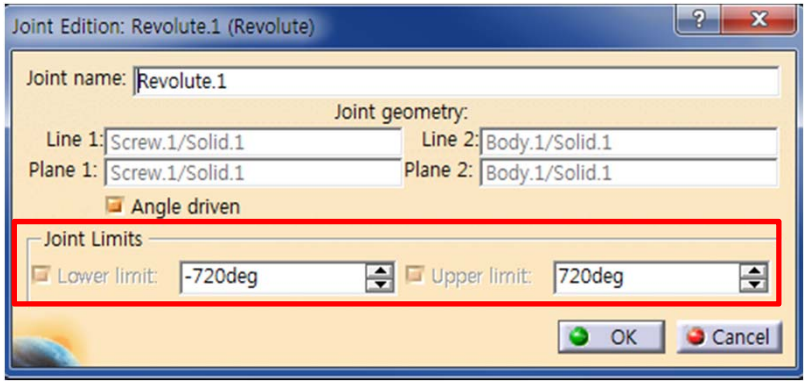
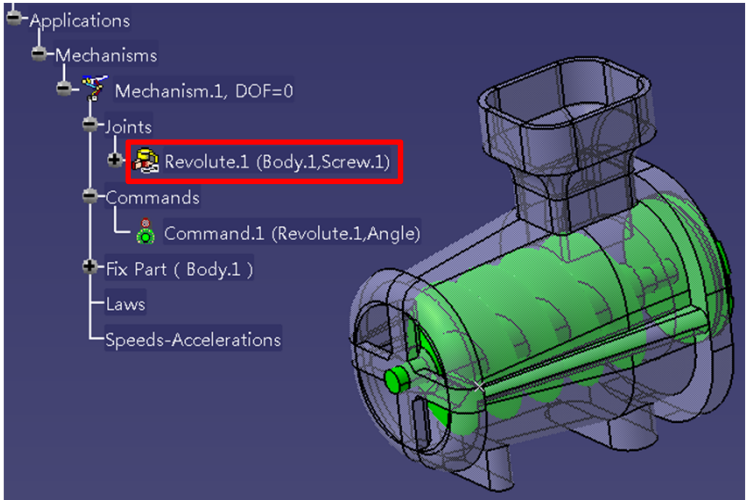


Revolute Joint 

- 두 component가 평면을 기준으로 회전하도록 joint 생성

Joint 생성 후, 생성한 Joint를 더블 클릭하여 Joint Limits 조절 가능





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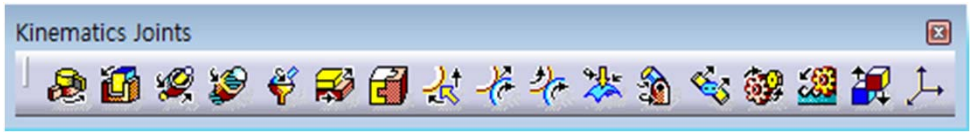
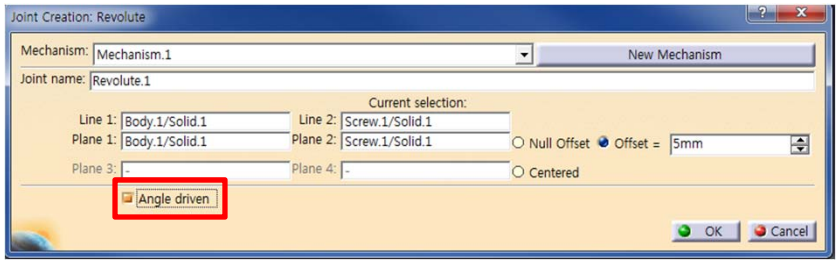


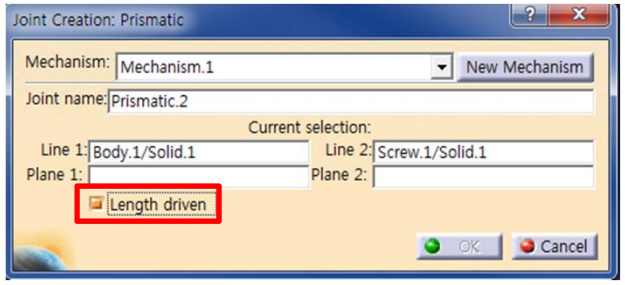
Angle driven/Length driven

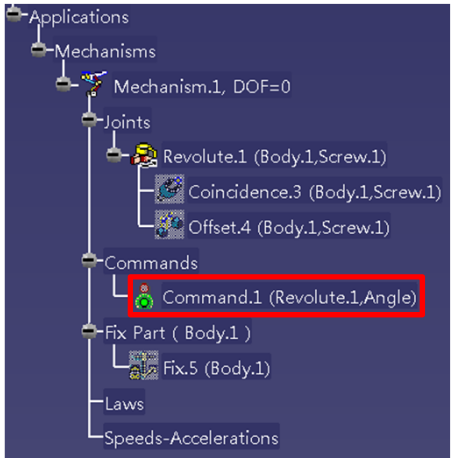
- 체크 할 경우 작업 트리에 Command로 생성되며 (오른쪽 그림의 Command.1), 시뮬레이션 툴에서 사용자가 조절 가능한 Command로 나타남. Mechanism 구성 시 최소한 하나의 Command는 필요하며, 체크하지 않을 경우 다른 Joint 운동에 의존하여 움직임.

Revolute Joint의 Angle driven

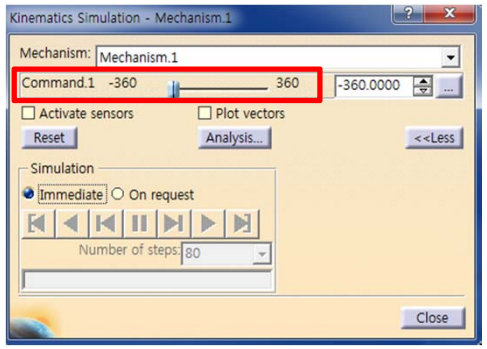


Prismatic Joint의 Length driven





Joint 생성 후 작업트리



Simulation with Commands

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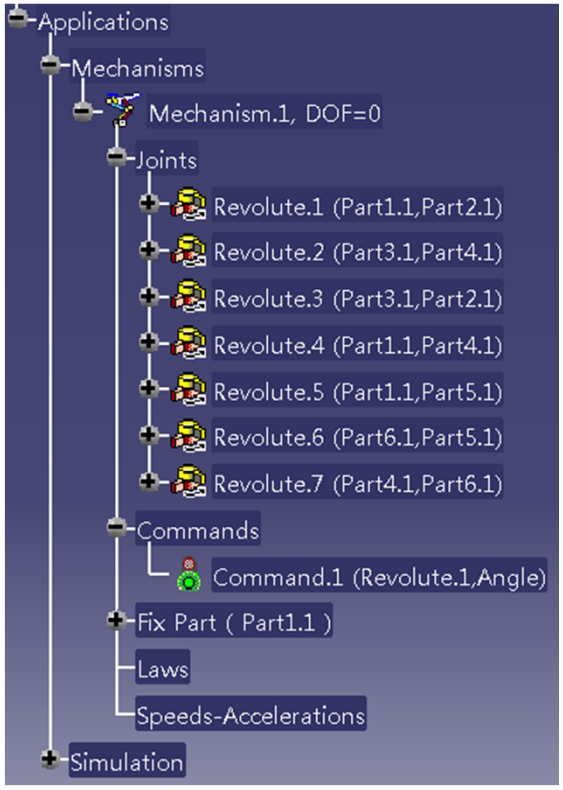
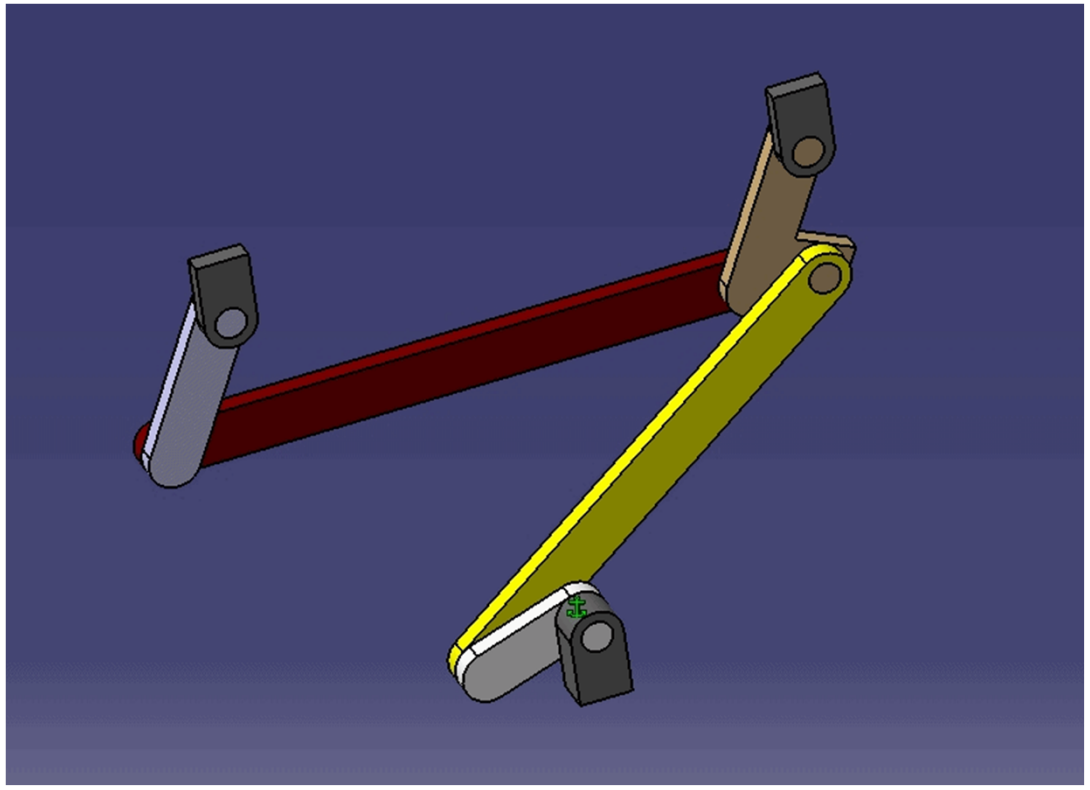
Wiper Mechanism (Revolute Joint)





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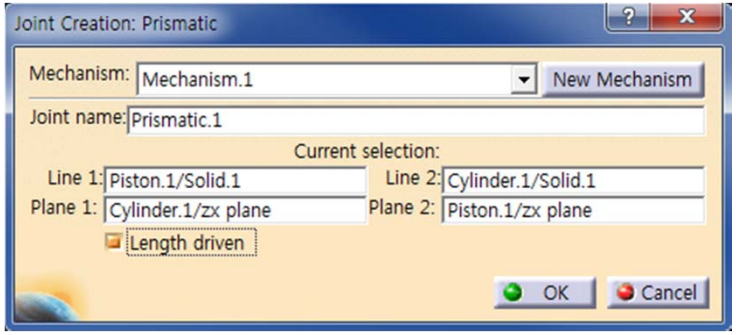
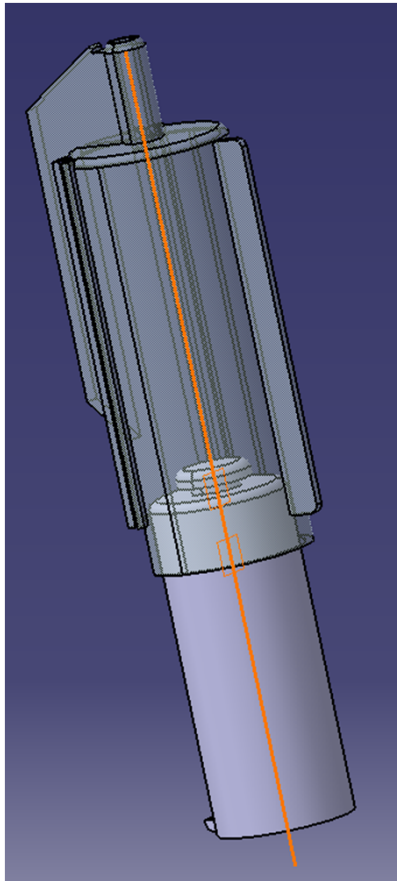
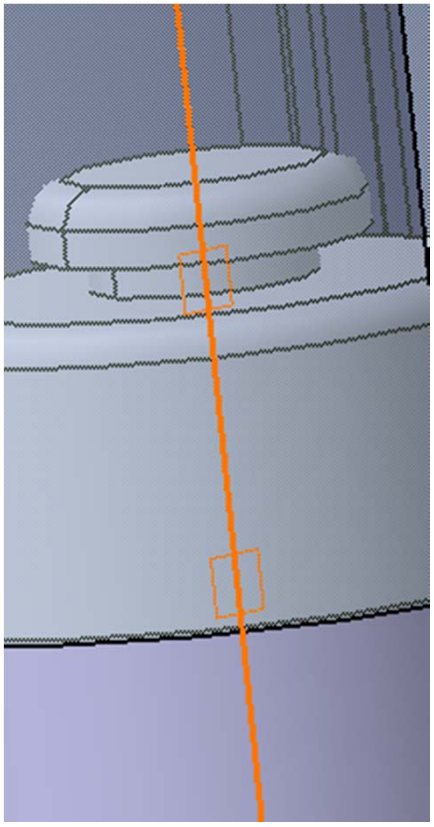
Prismatic Joint 

- 두 component가 특정 면을 기준으로 병진 운동하도록 joint 생성

<Line, Plane 선택>







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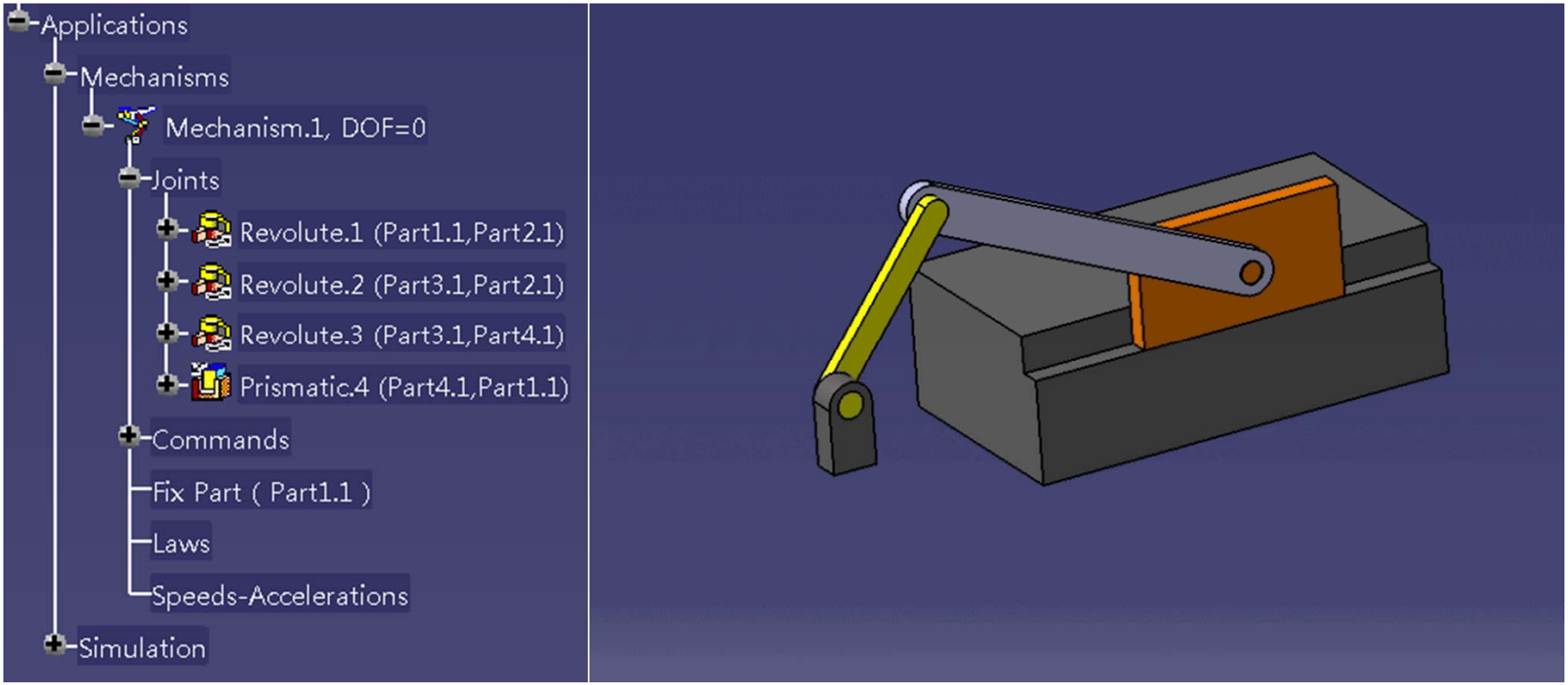
Crank-Slider Mechanism (Revolute Joint + Prismatic Joint)



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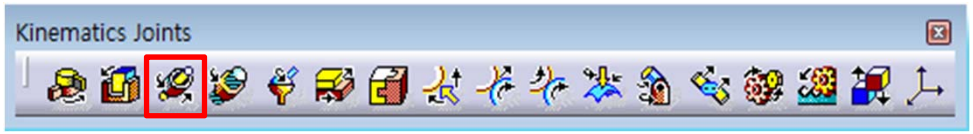
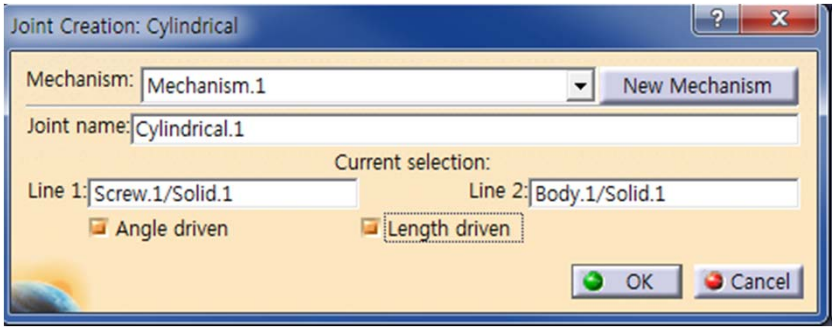
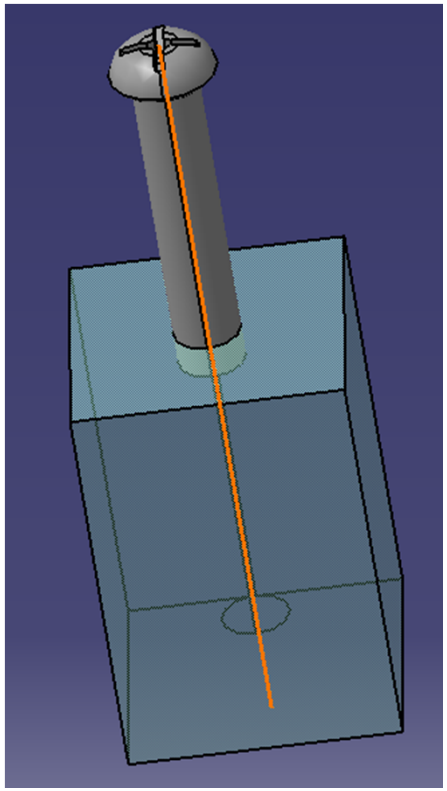


Cylindrical Joint 

- 두 component가 병진운동과 회전 운동하도록 joint 생성

<Line 선택>





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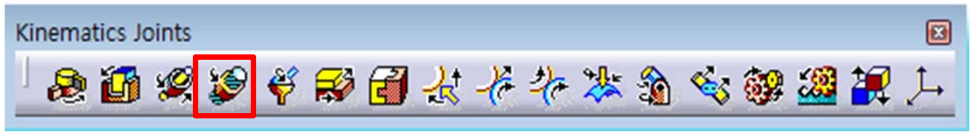
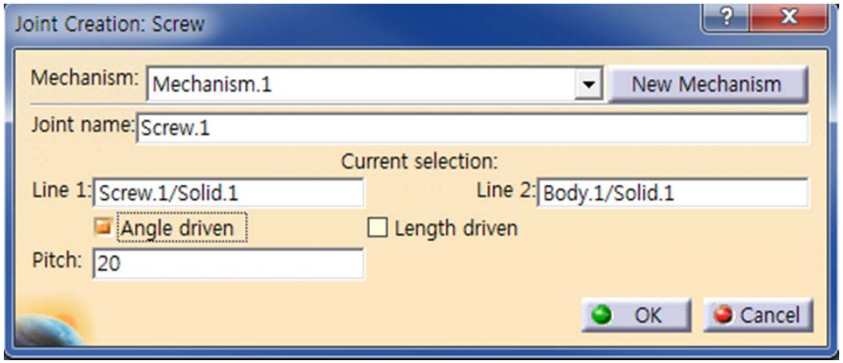


Screw Joint 

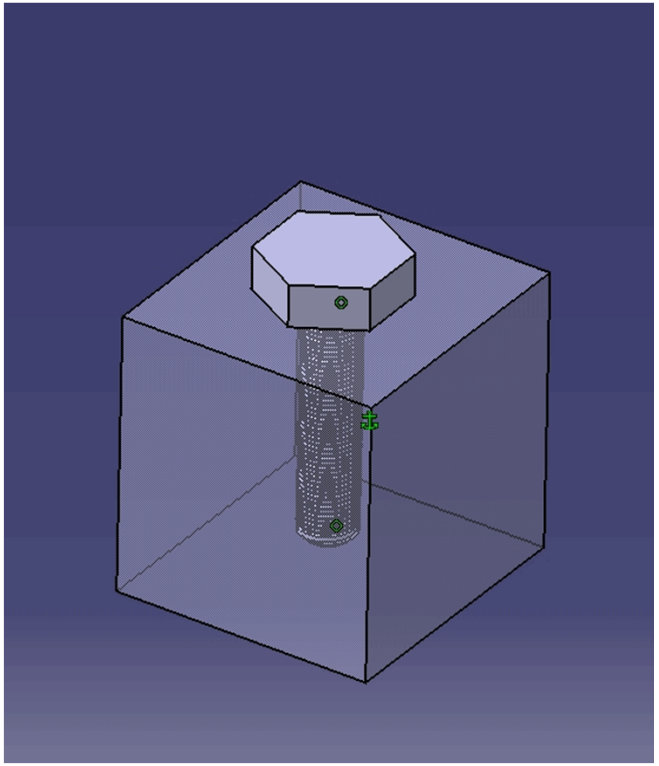
- 두 component가 pitch 값을 기준으로 회전과 병진 운동하도록 joint 생성

<Line 선택, Pitch값 입력>



Angle driven & Pitch : 지정해준 각도만큼 회전하며, 360도 회전할 때 지정한 pitch 값 만큼 이동함.

Length driven & Pitch : 지정해준 길이만큼 움직이며, 입력한 pitch 값 만큼 이동할 때 360도 회전함.



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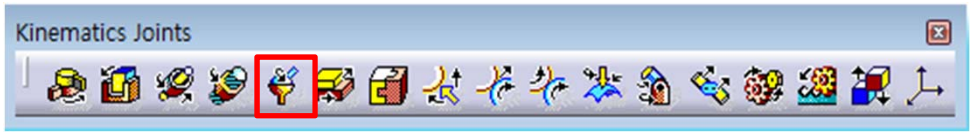
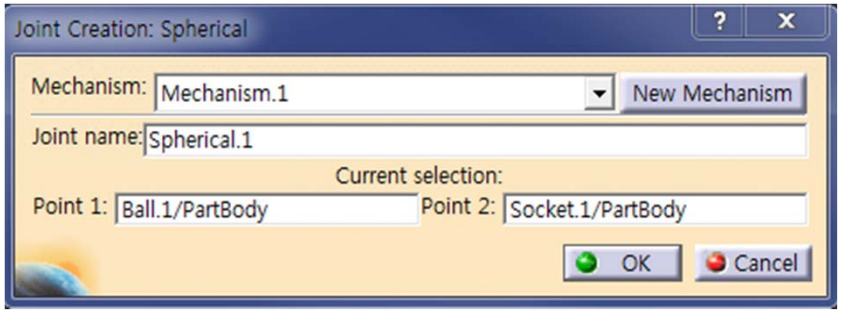
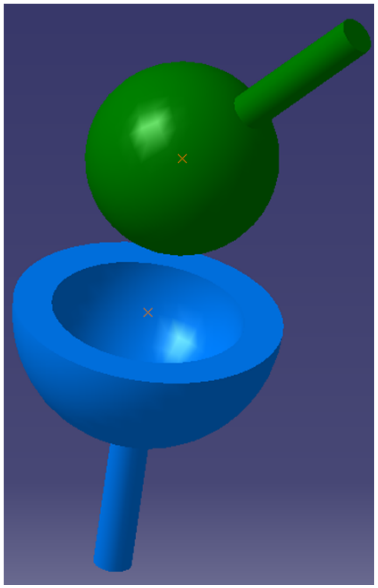


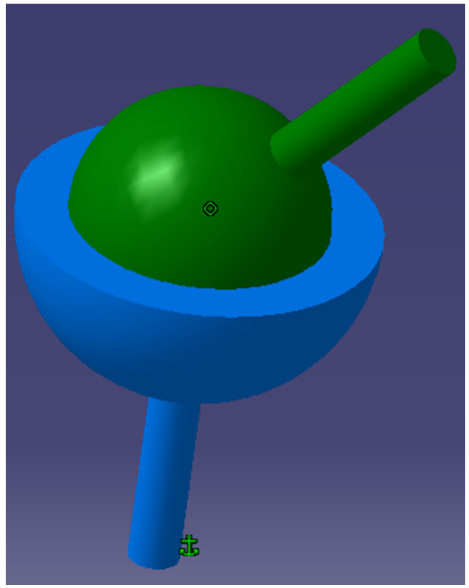
Spherical Joint 

- 두 component가 특정한 point를 중심으로 운동하도록 joint 생성

<Point 선택>







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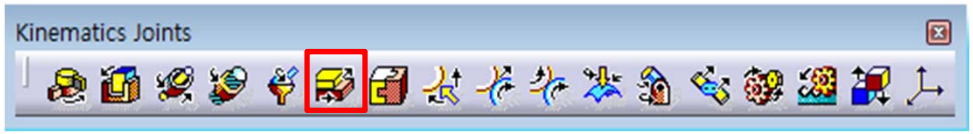
DMU KINEMATICS TOOLS

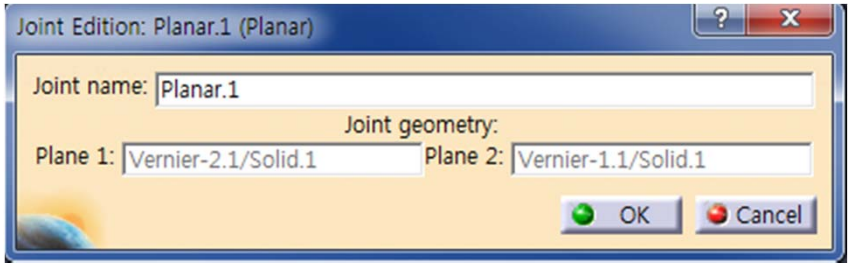
DMU Kinematics

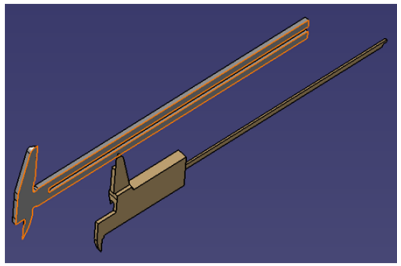


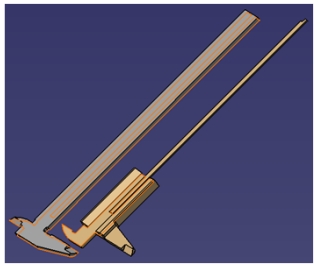
Planar Joint 

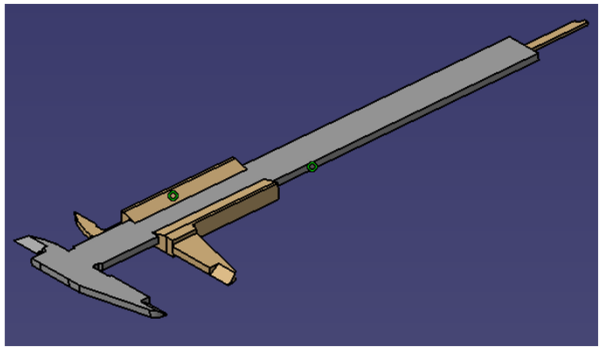
- 두 component가 특정한 plane를 중심으로 운동하도록 joint 생성

<Plane 선택>









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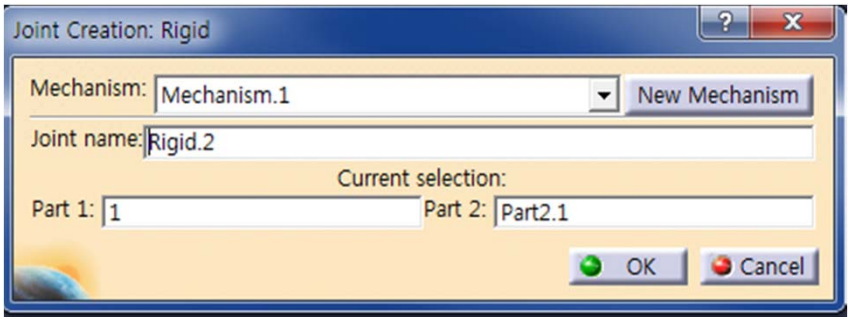
DMU KINEMATICS TOOLS

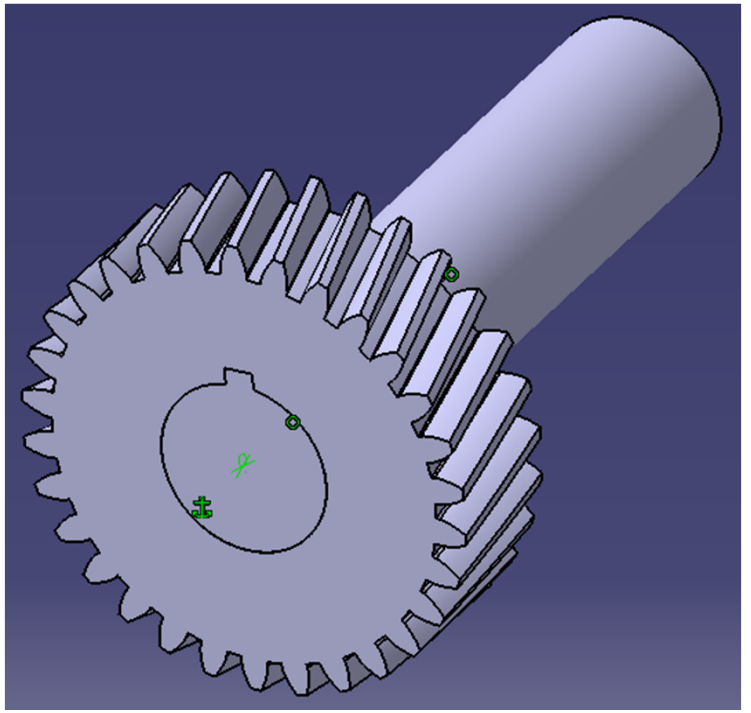
DMU Kinematics

Rigid Joint 

- 두 component의 상대위치를 고정시켜주는 joint를 생성

<Component 선택>





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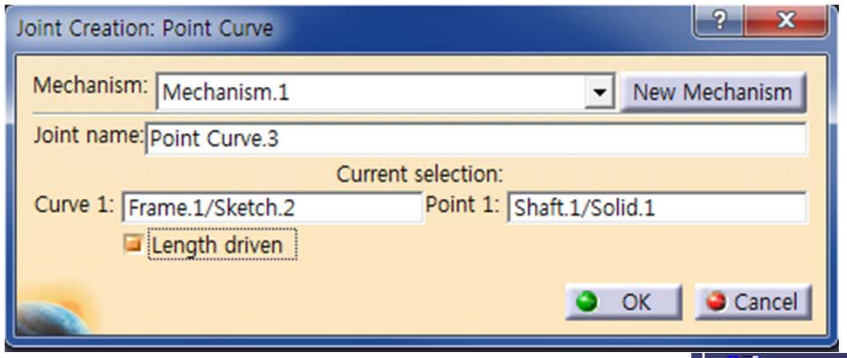
DMU KINEMATICS TOOLS

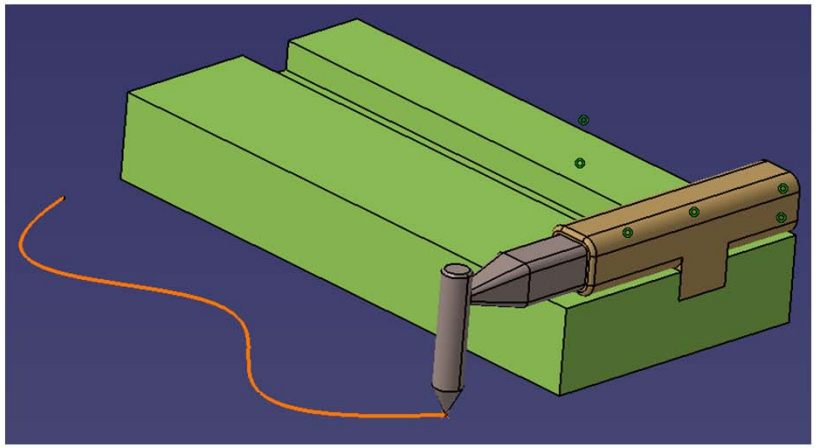
DMU Kinematics

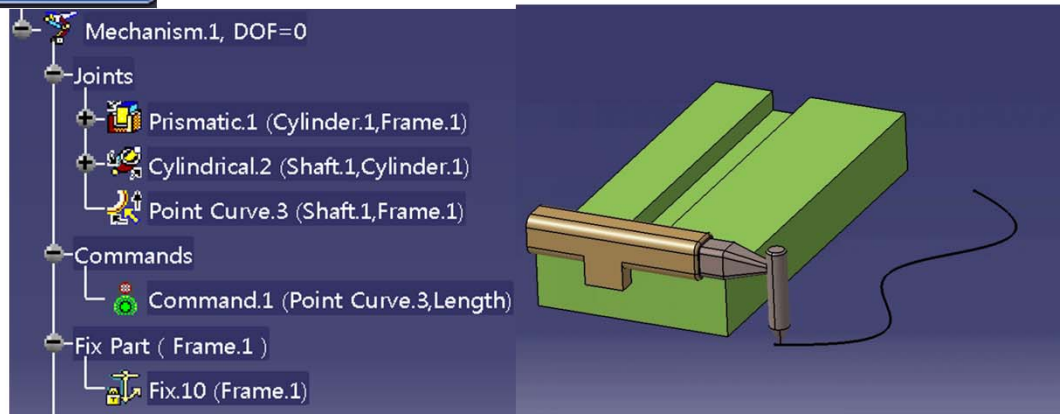
Point Curve Joint 

- 특정 점이 특정 곡선을 따라 움직이도록 joint 생성

<Curve, Point 선택>







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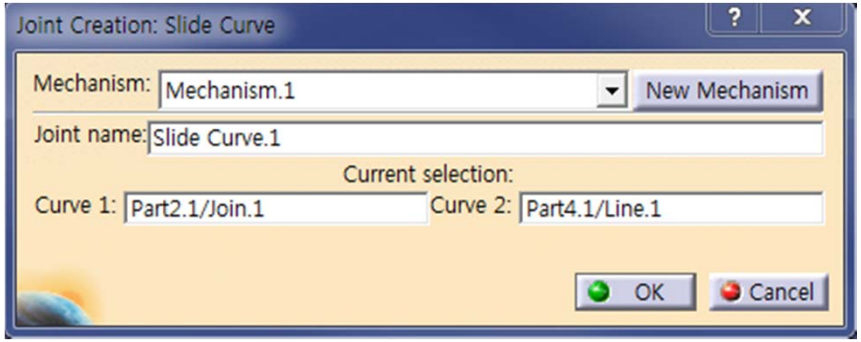
DMU KINEMATICS TOOLS

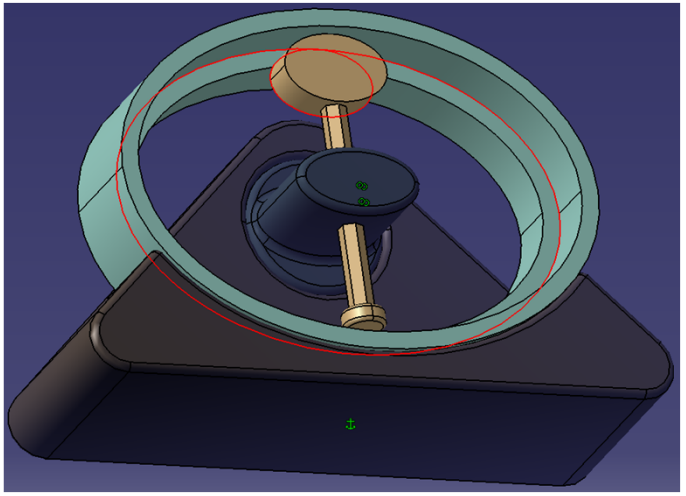
DMU Kinematics

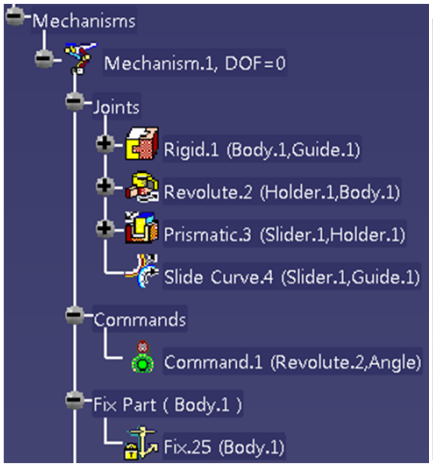
Slide Curve Joint 

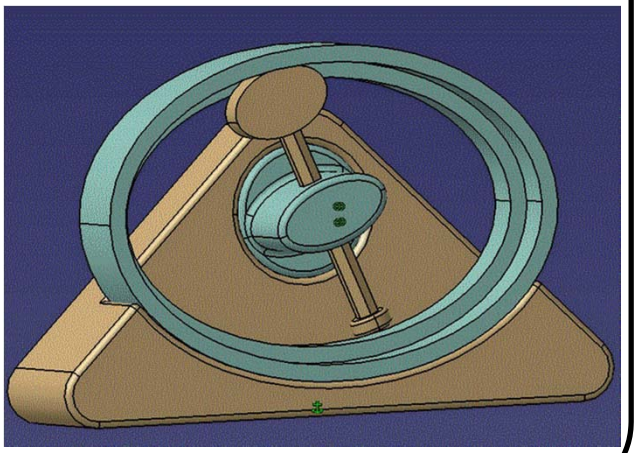
- 특정 곡선이 다른 곡선을 따라 움직이도록 joint 생성

<Curve 선택>









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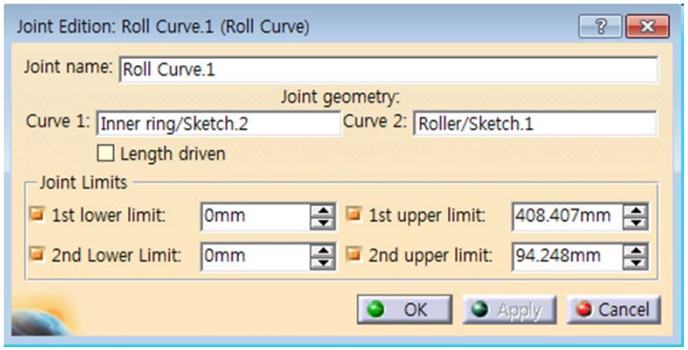
DMU KINEMATICS TOOLS

DMU Kinematics

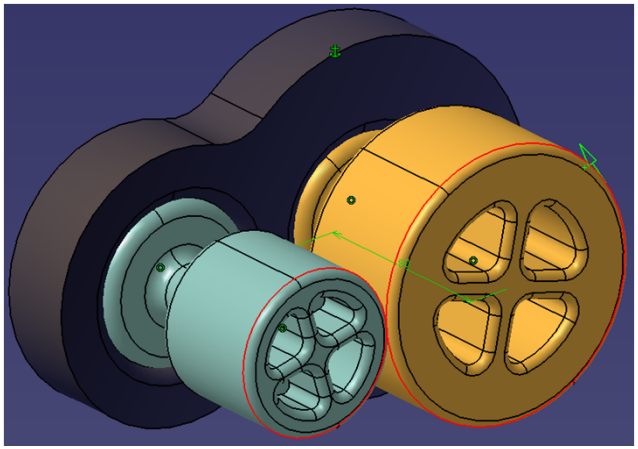
Roll Curve Joint 

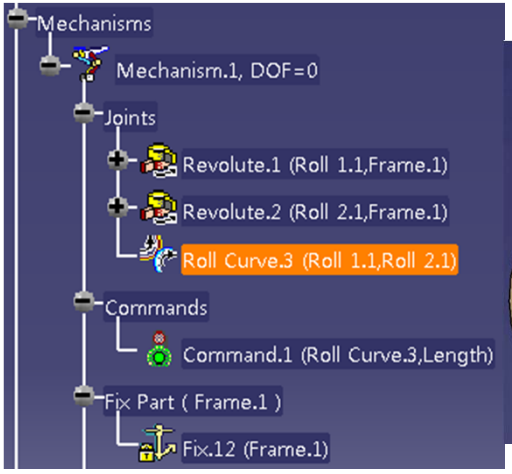
- 특정 곡선끼리 맞물려 움직이도록 joint 생성

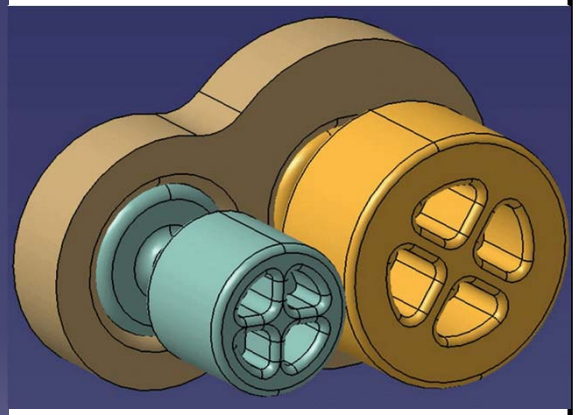
<Curve 선택>



Roll Curve Joint







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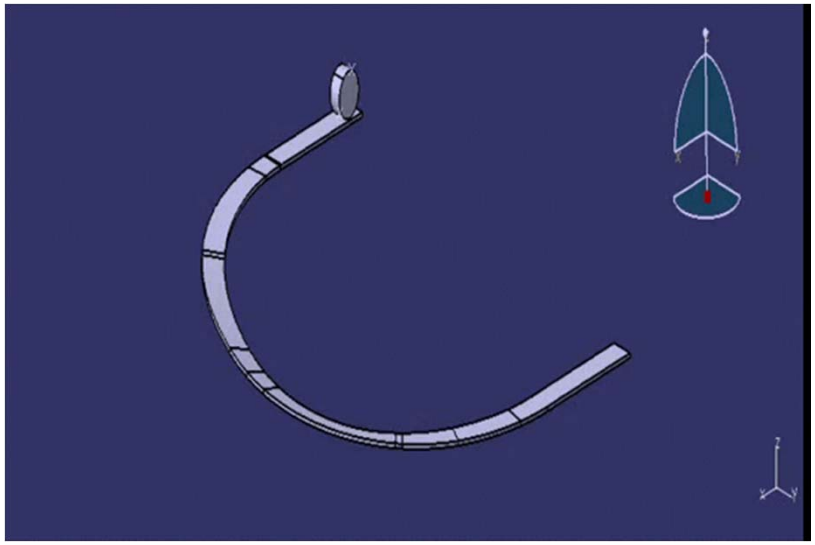
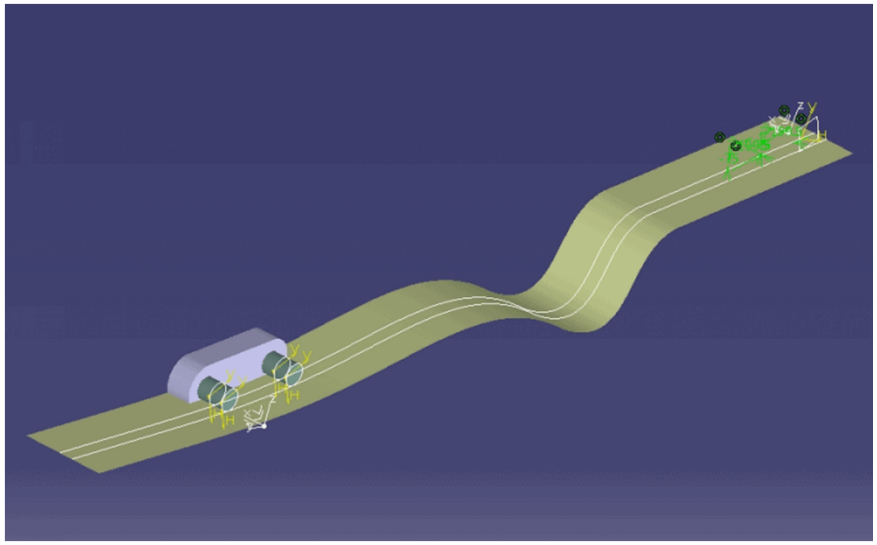
DMU KINEMATICS TOOLS

DMU Kinematics

Slide Curve Joint + Roll Curve Joint





http://cadsystemshelp.blogspot.kr/2012/03/how-do-you-simulate-rolling-in-catia.html

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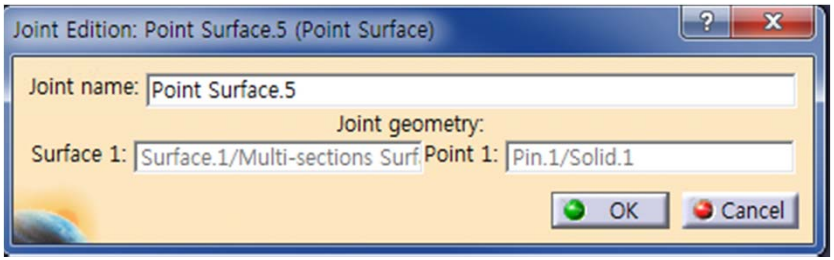
DMU KINEMATICS TOOLS

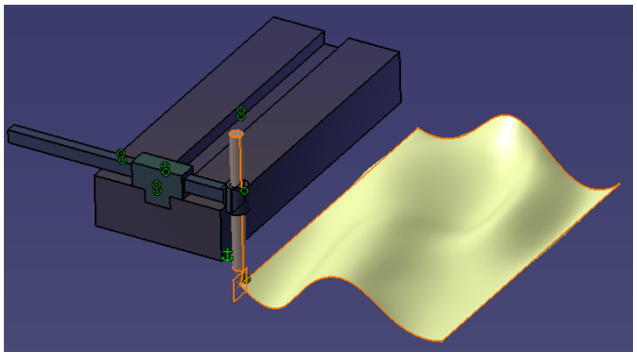
DMU Kinematics

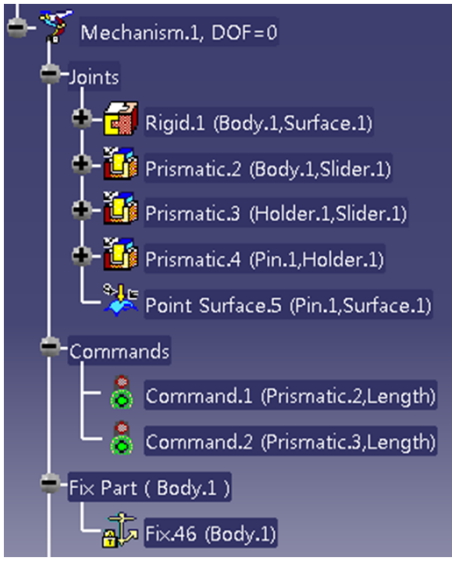
Point Surface Joint 

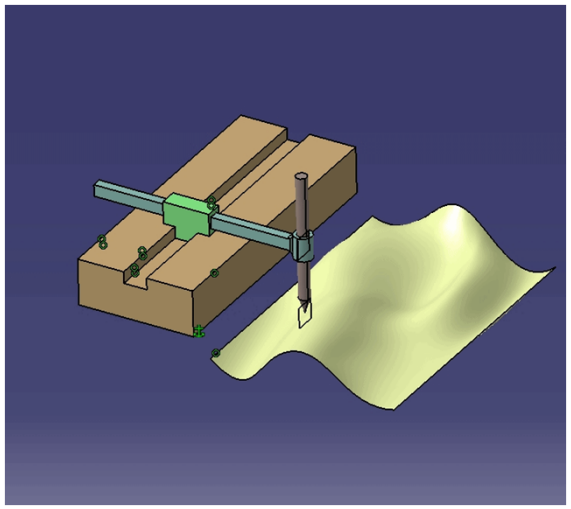
- 특정 점이 특정 곡면을 따라 움직이도록 joint 생성

<Surface, Point 선택>









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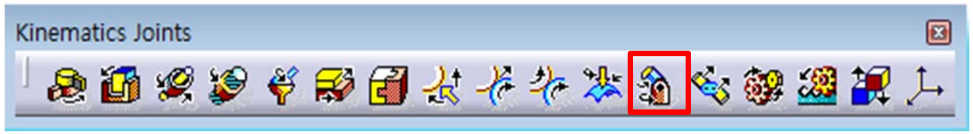
DMU KINEMATICS TOOLS

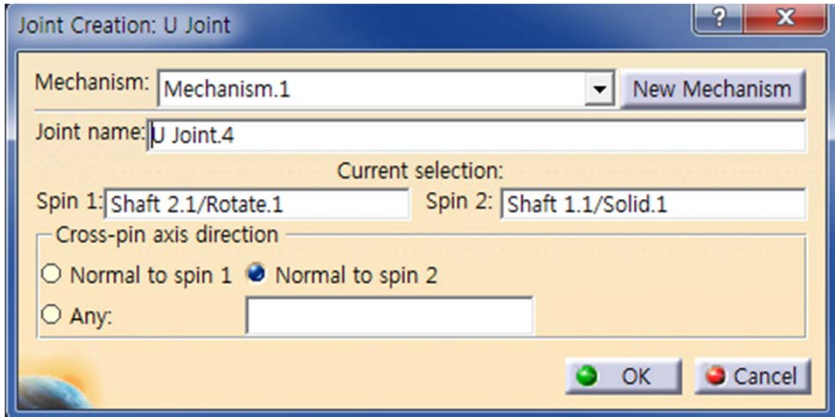
DMU Kinematics

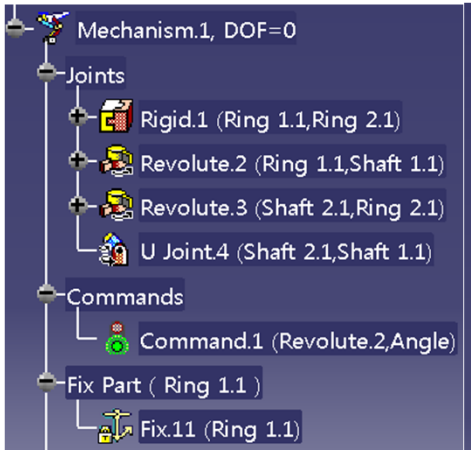


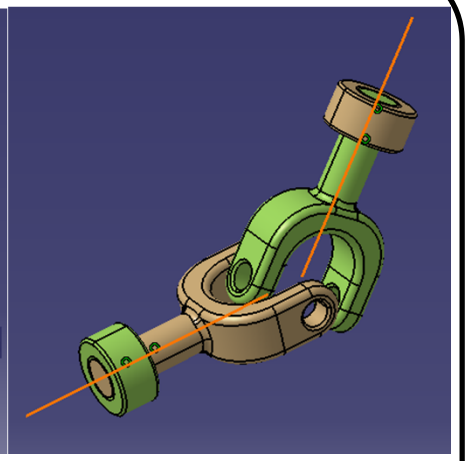
Universal Joint 

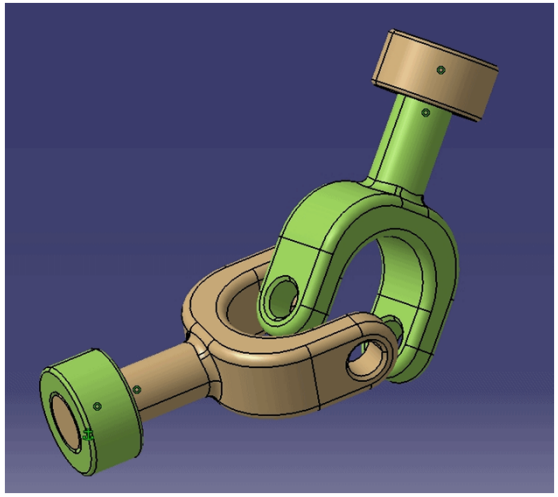
- 두 축을 연결해주기 위한 joint 생성

<연결할 축 선택>









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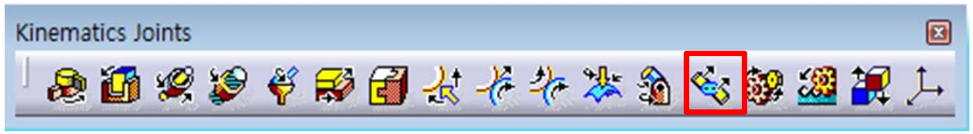
DMU KINEMATICS TOOLS

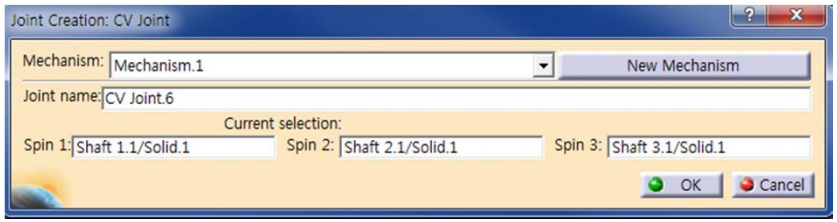
DMU Kinematics

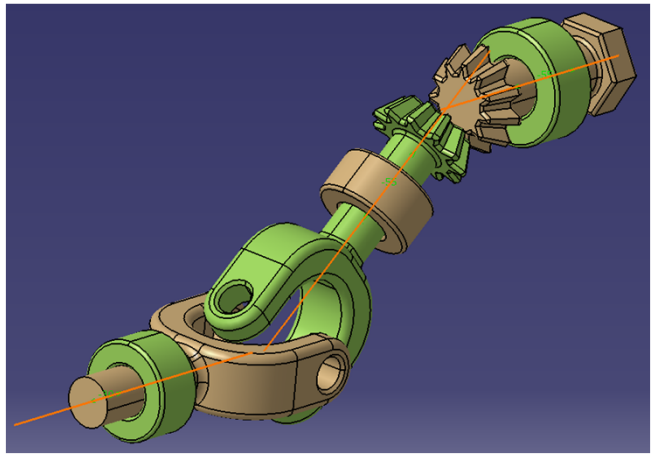


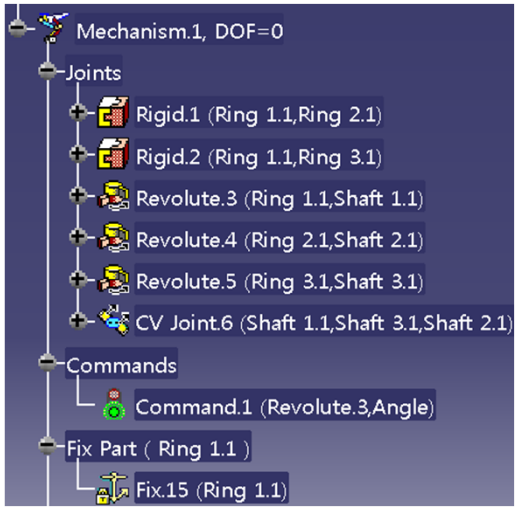
CV Joint 

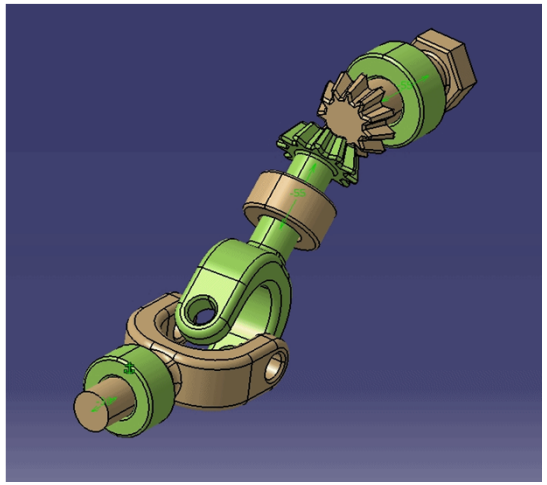
- 3개의 축을 연결해 주기 위한 joint 생성

<연결할 축 선택>









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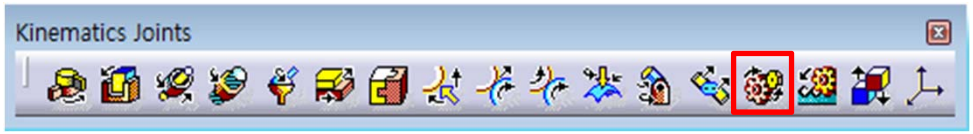
DMU KINEMATICS TOOLS

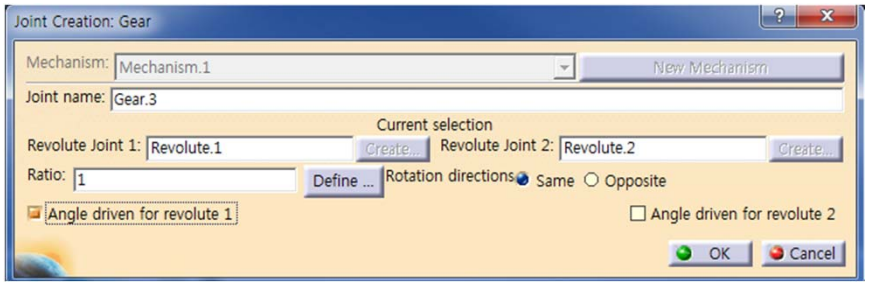
DMU Kinematics



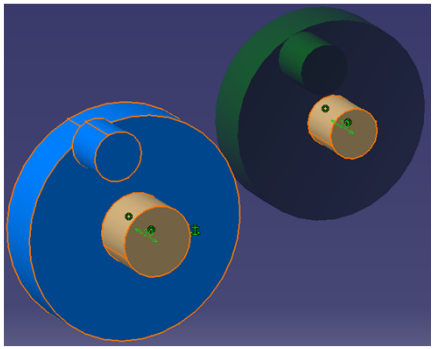
Gear Joint 

- 기어 비를 이용하여 회전운동 하도록 joint 생성

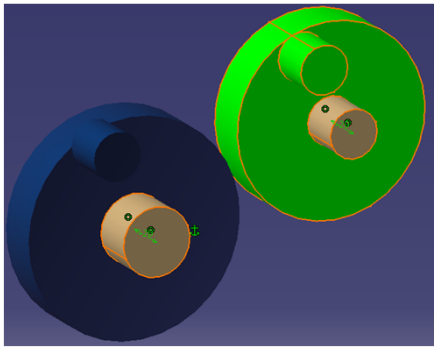
<Revolute joint 선택>



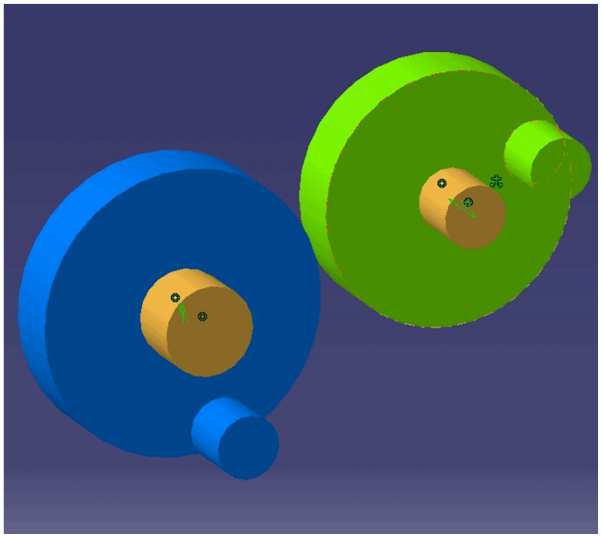
: $Ratio = \frac{Revolute\ Joint\ 2 \text{ 의 회전수}}{Revolute\ Joint\ 1 \text{ 의 회전수}}$



<Revolute Joint 1>



<Revolute Joint 2>



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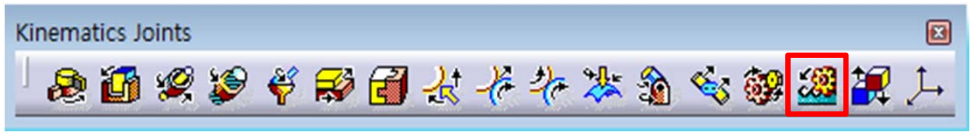
DMU KINEMATICS TOOLS

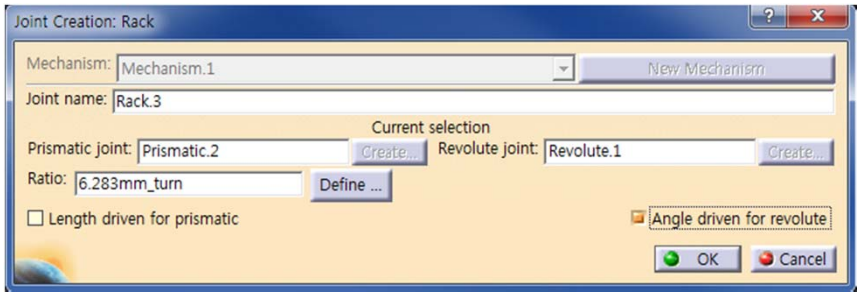
DMU Kinematics



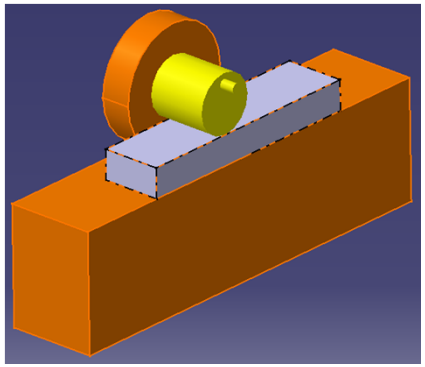
Rack Joint 

- 기어 비를 이용하여 회전/병진 운동하도록 joint 생성

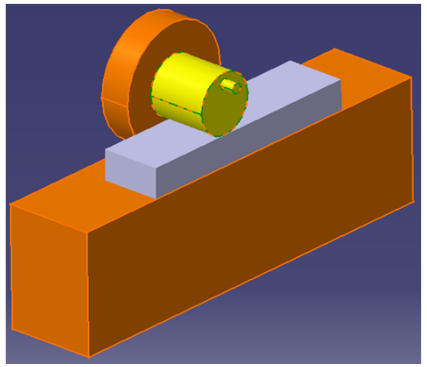
<Prismatic, Revolute 선택>



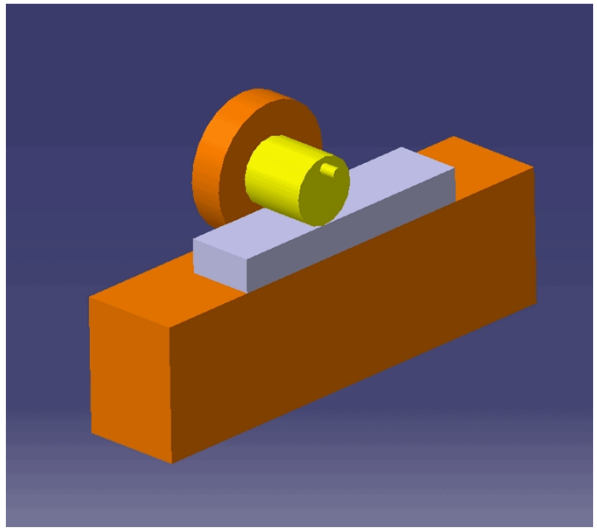
: $Ratio$ = 이동 길이/회전



<Prismatic>



<Revolute>



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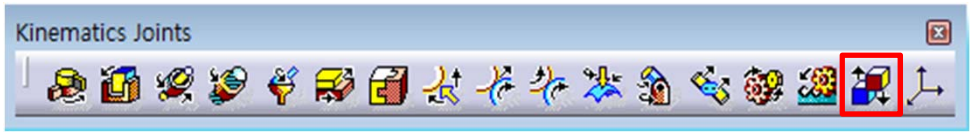
DMU KINEMATICS TOOLS

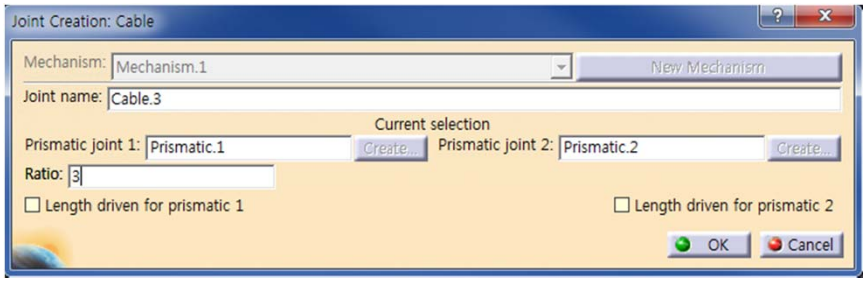
DMU Kinematics



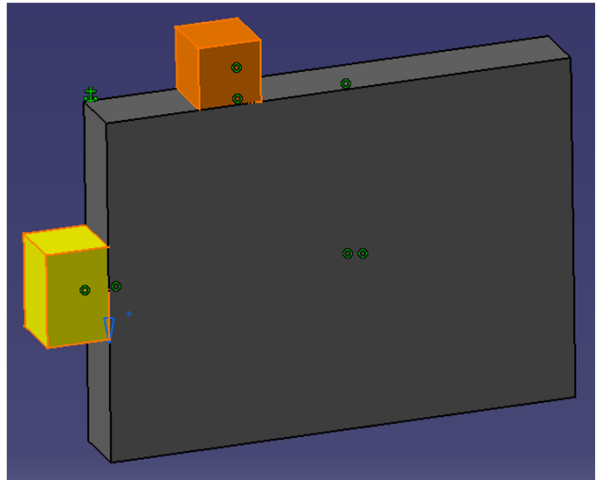
Cable Joint 

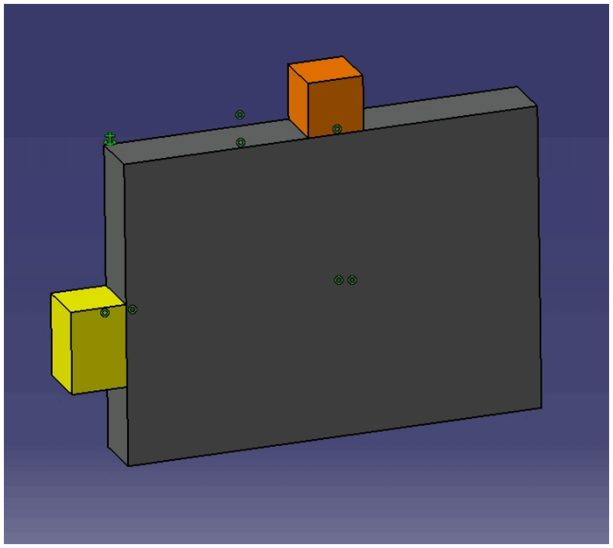
- Cable이 연결 된 것처럼 움직이도록 joint 생성

<Prismatic joint 선택>



: $Ratio = \frac{Prismatic\ Joint\ 2\text{의 이동길이}}{Prismatic\ Joint\ 1\text{의 이동길이}}$





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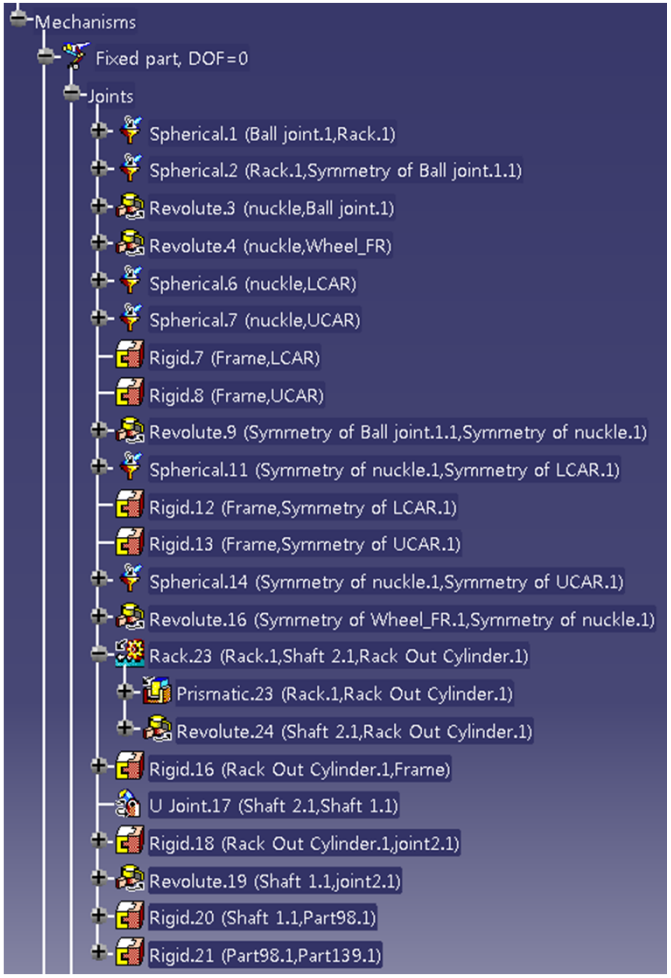
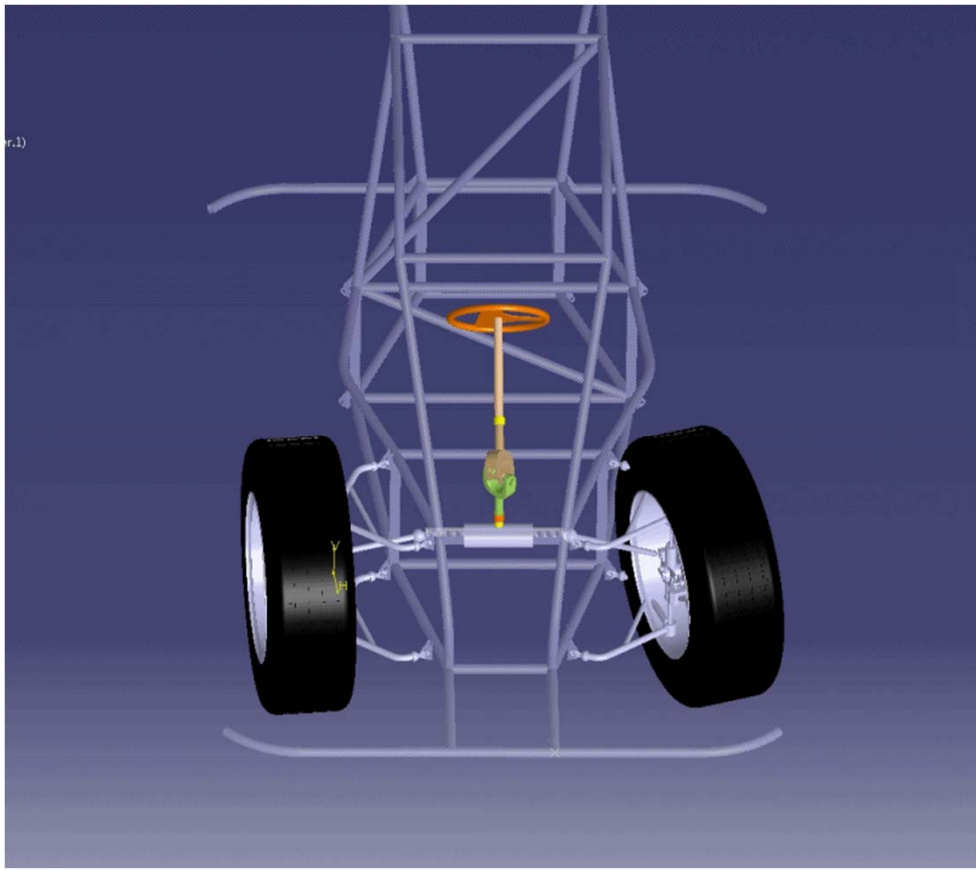
DMU KINEMATICS TOOLS

DMU Kinematics

Steering System Mechanism





2012 CAD Project – '조석' 팀 수정 자료

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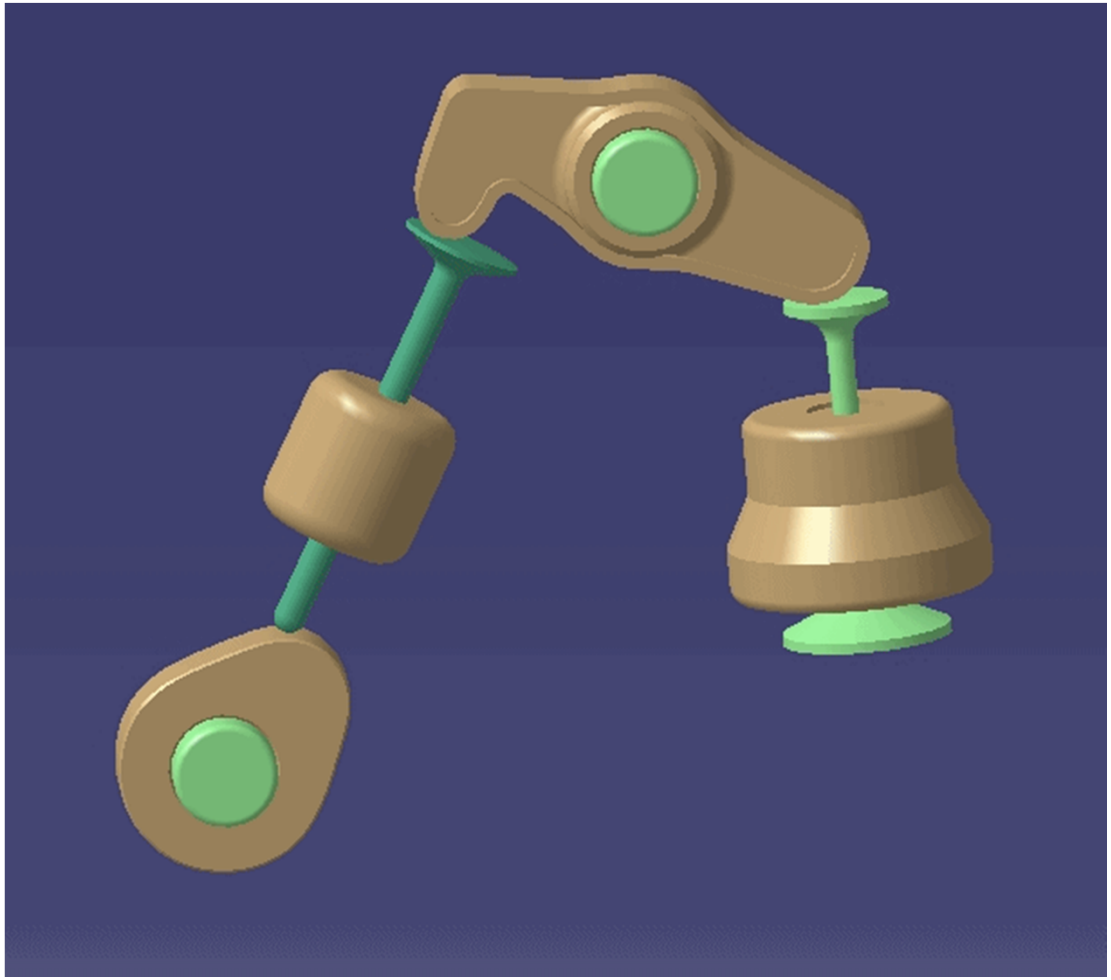
실습 예제

홈페이지의 Practice 파일을 이용하여 아래의 그림과 같이 DMU Kinematics 작업을 진행하기



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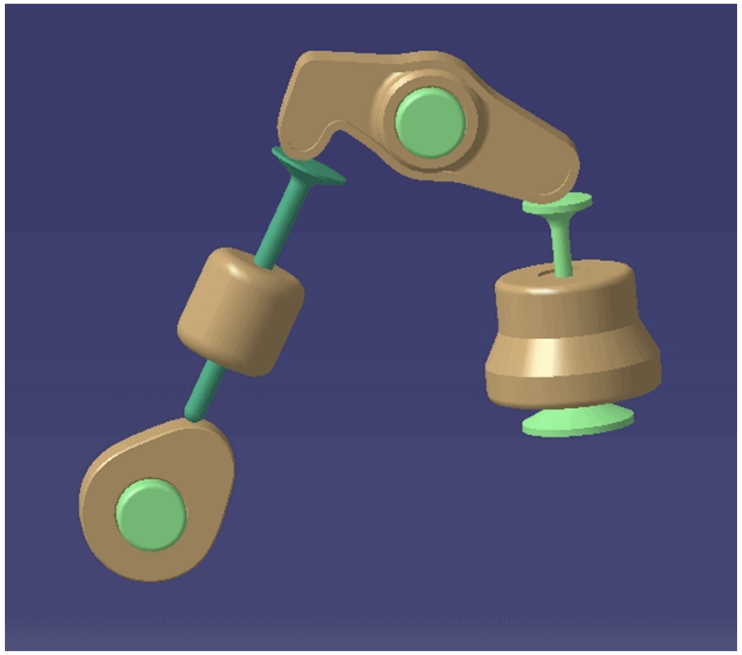
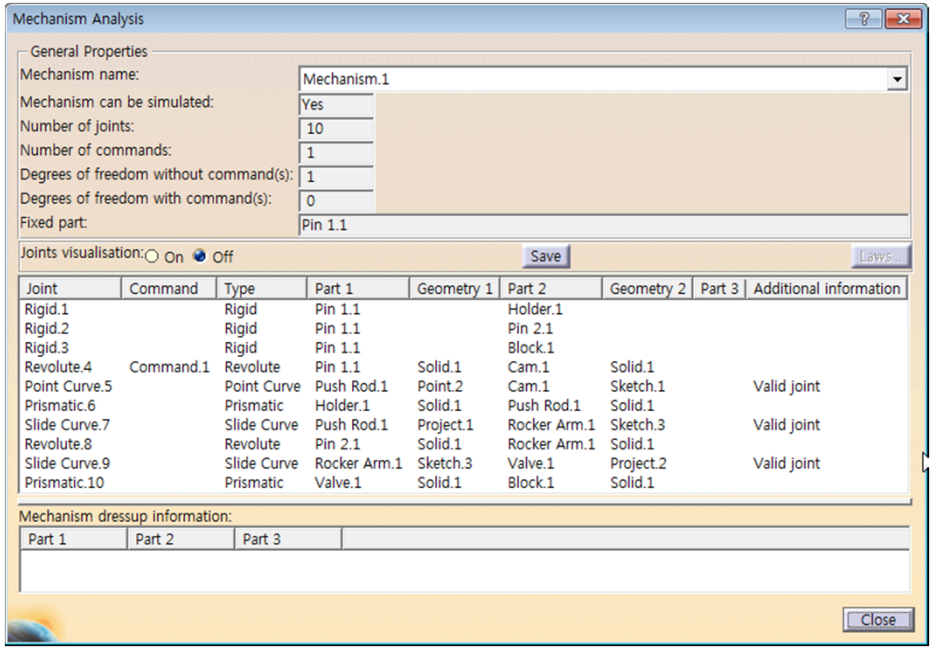
DMU KINEMATICS TOOLS

DMU Kinematics

Mechanism Analysis 

-생성된 joint들의 연결 상태를 확인함





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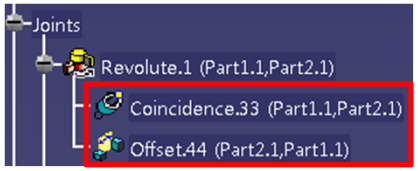
DMU KINEMATICS TOOLS

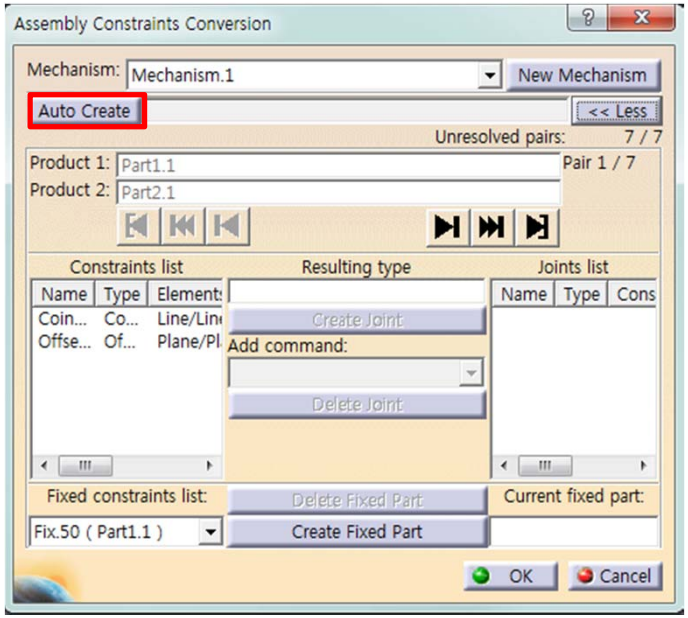
DMU Kinematics

Assembly Constraints Conversion

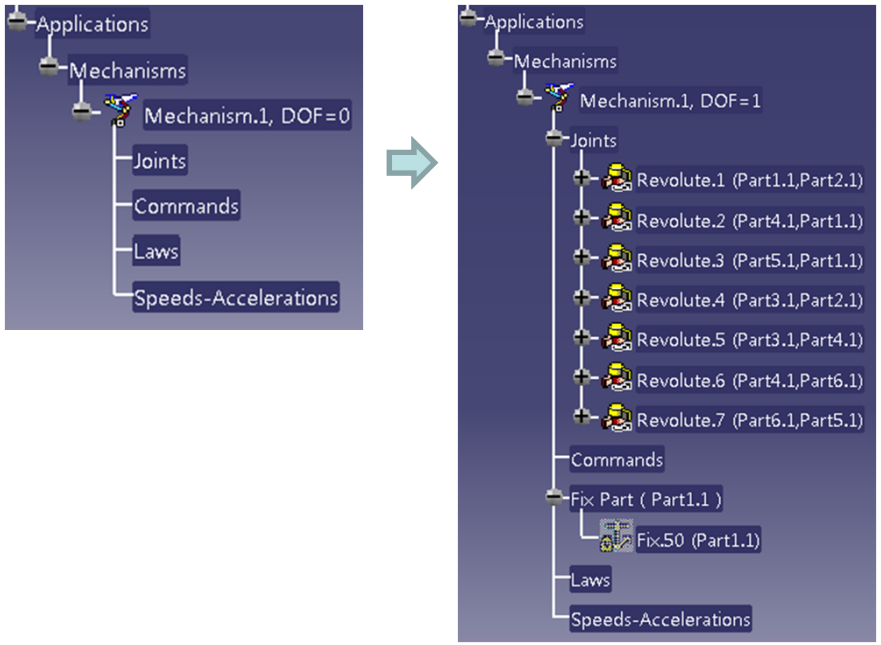
- Assembly Design에서 생성한 constraint를 Joint로 변경



여러 개의 constraint로 구성된 joint



Joint 자동 생성



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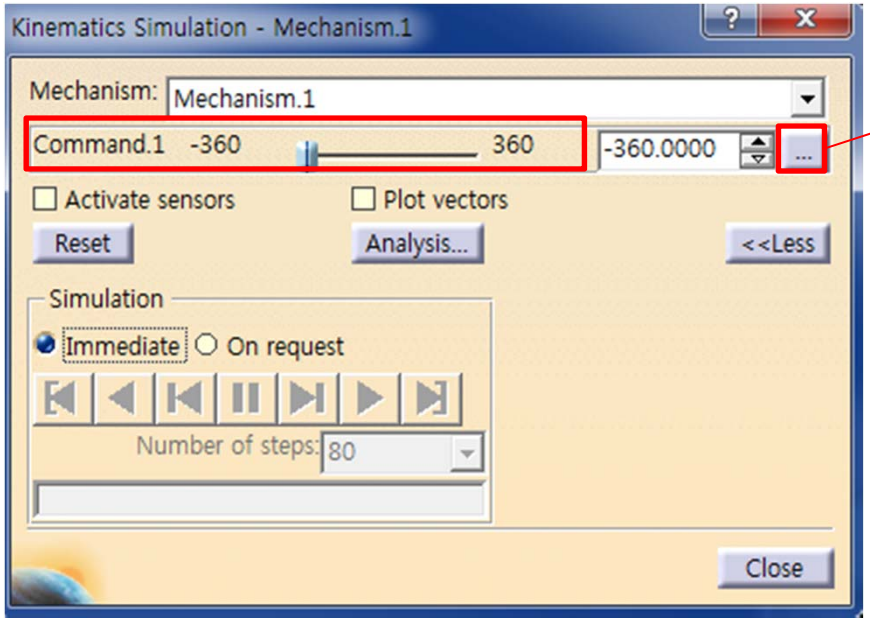
DMU KINEMATICS TOOLS

DMU Kinematics

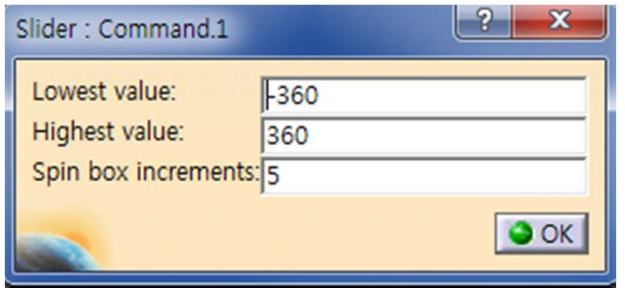
Simulation with Commands 

- 생성된 mechanism이 command를 기준으로 동작

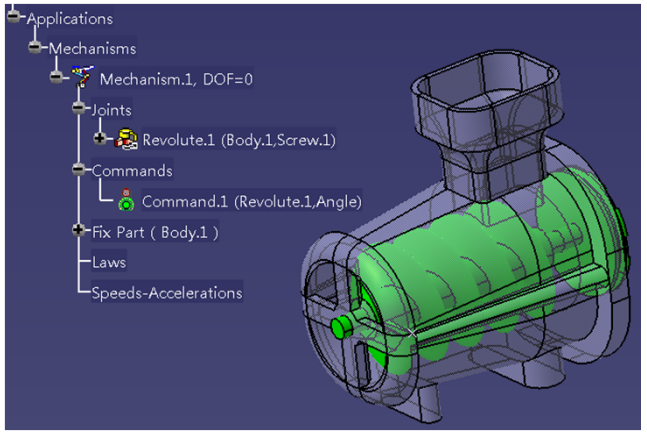


Joint에서의 Angle/Length driven 수만큼 Command가 생성됨

Command의 Limits 조절 가능



Revolute Joint 모델



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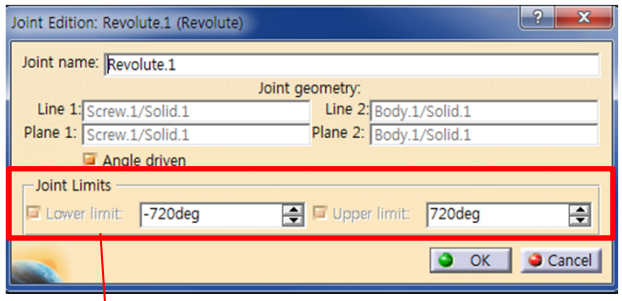
DMU KINEMATICS TOOLS

DMU Kinematics

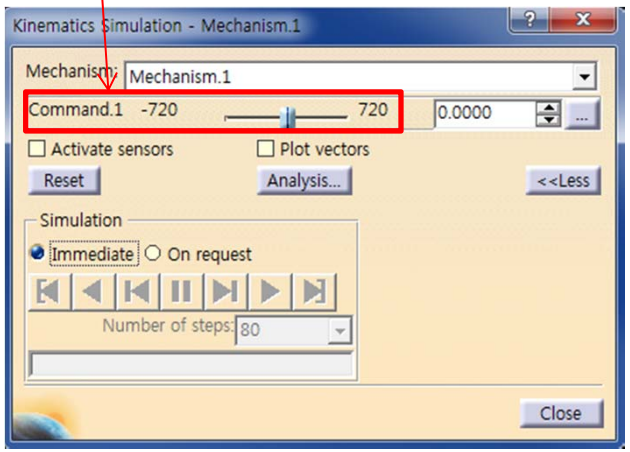
Simulation with Commands 

- 생성된 mechanism이 command를 기준으로 동작

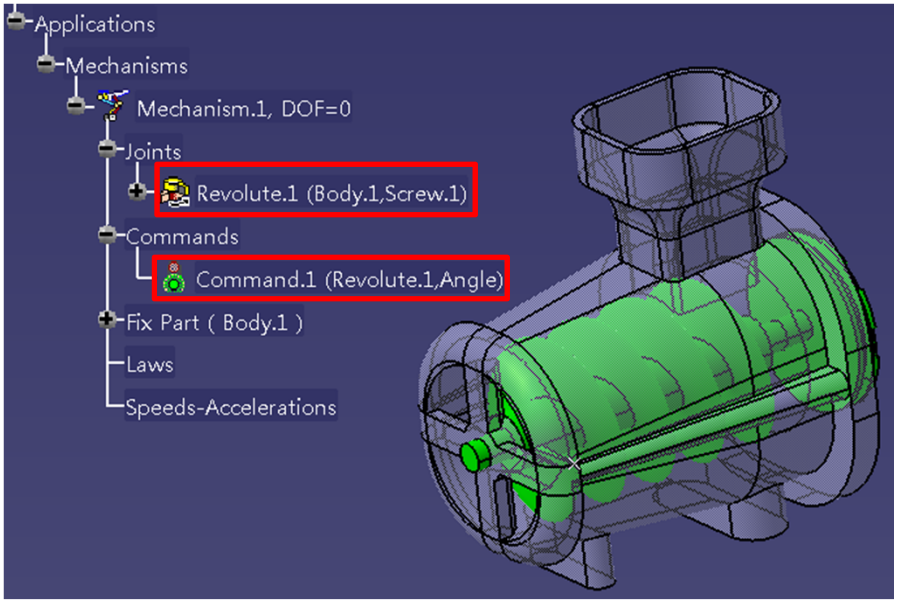
생성한 Joint를 더블 클릭하여 Limits 조절 가능



Simulation Command의 Limits이 됨



Revolute Joint 모델



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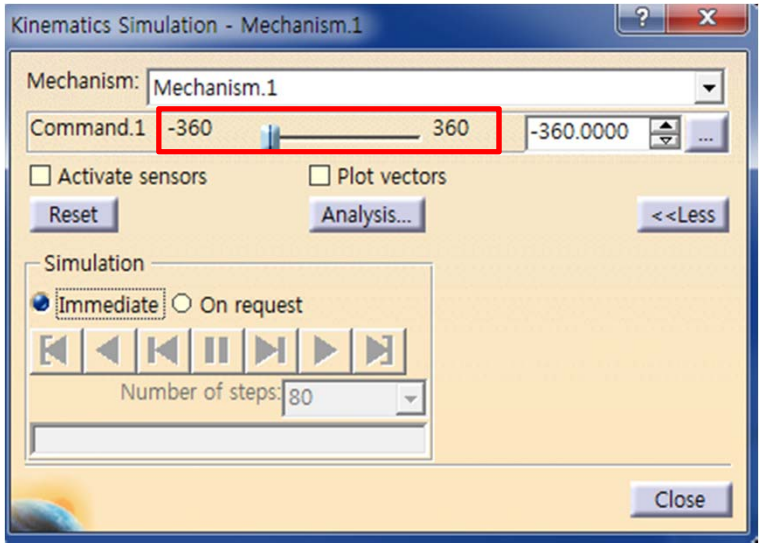
DMU KINEMATICS TOOLS

DMU Kinematics 

Simulation with Commands 

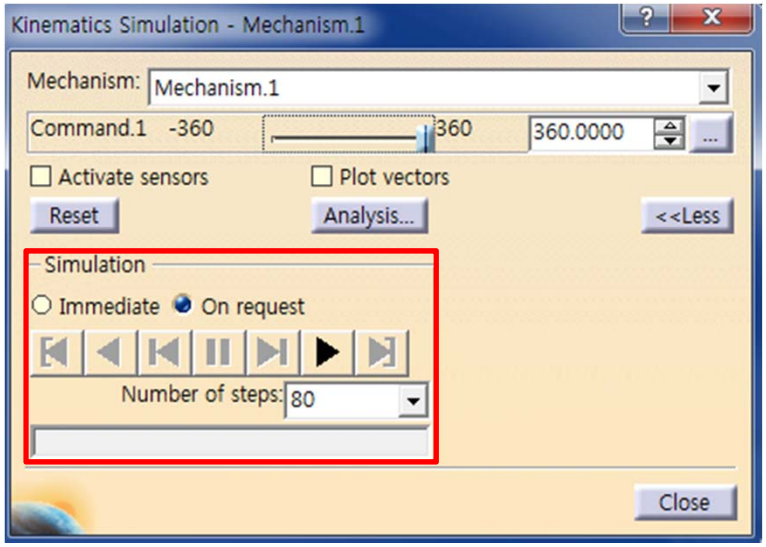
- 생성된 mechanism이 command를 기준으로 동작

스크롤이 이동하는 만큼 mechanism이 구동



Simulation: Immediate

움직인 command 값을 steps수로 나누어 연속적으로 구동



Simulation: On request

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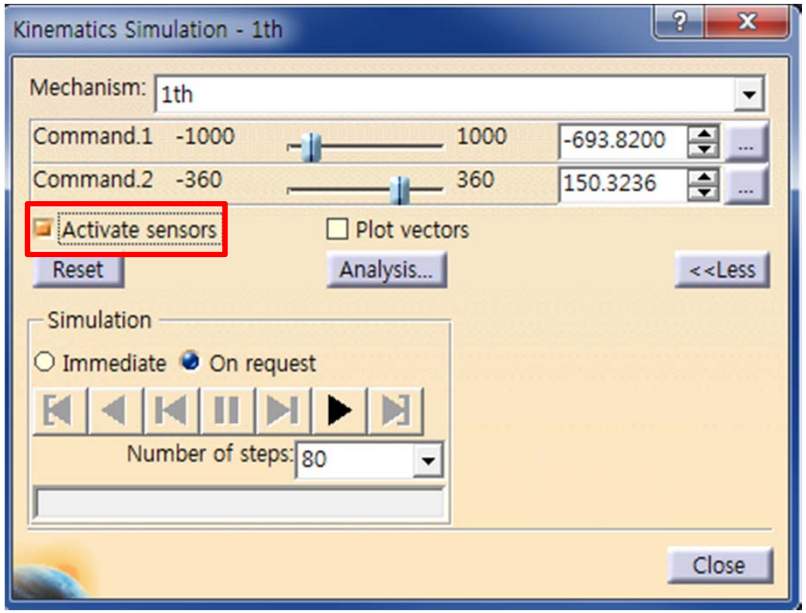
DMU KINEMATICS TOOLS

DMU Kinematics

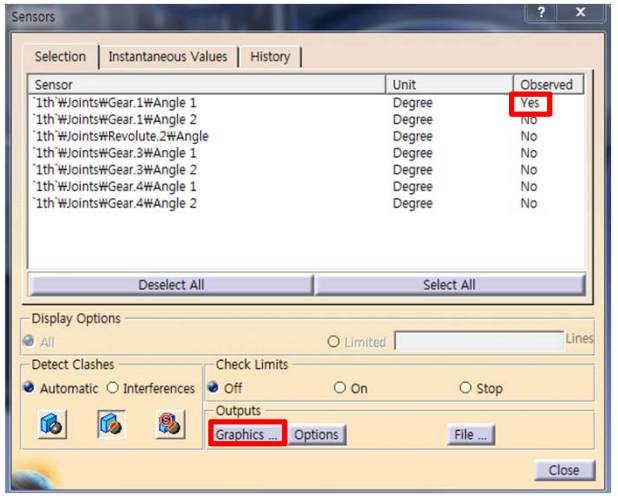
Simulation with Commands 

- 생성된 mechanism이 command를 기준으로 동작

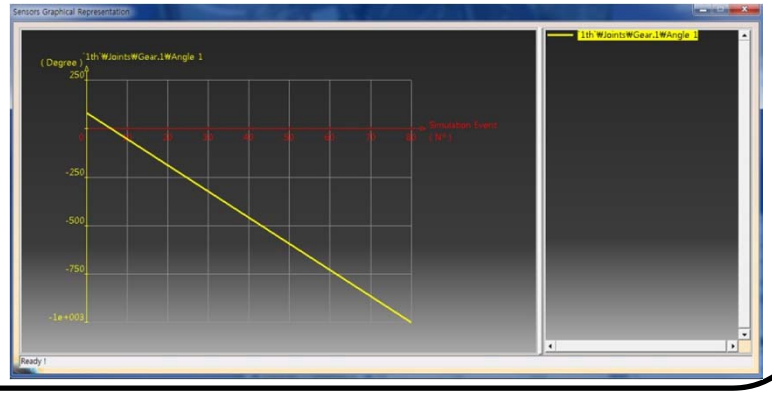
Command를 통해 움직인 Joint의 변화량을 그래프로 확인 가능



측정하고자 하는 Joint를 No→Yes로 변경 (클릭)



시뮬레이션 재생 후 위 그림의 Graphics를 클릭하면 결과 값이 그래프로 나타남



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DMU KINEMATICS TOOLS

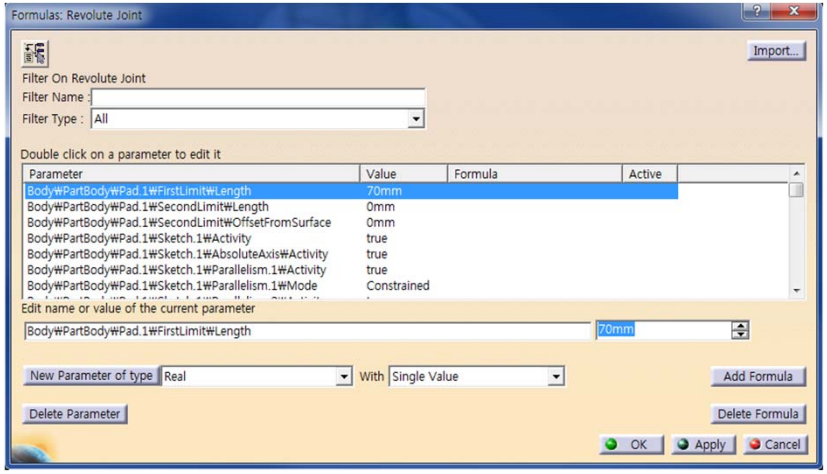
DMU Kinematics

Simulation with Laws 

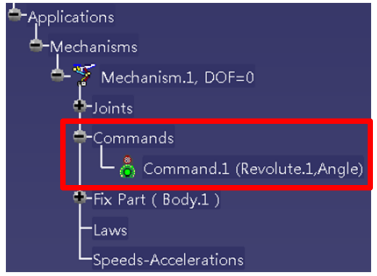
- 생성한 Formula를 기준으로 시뮬레이션 적용 (시간에 대한 변수 사용)

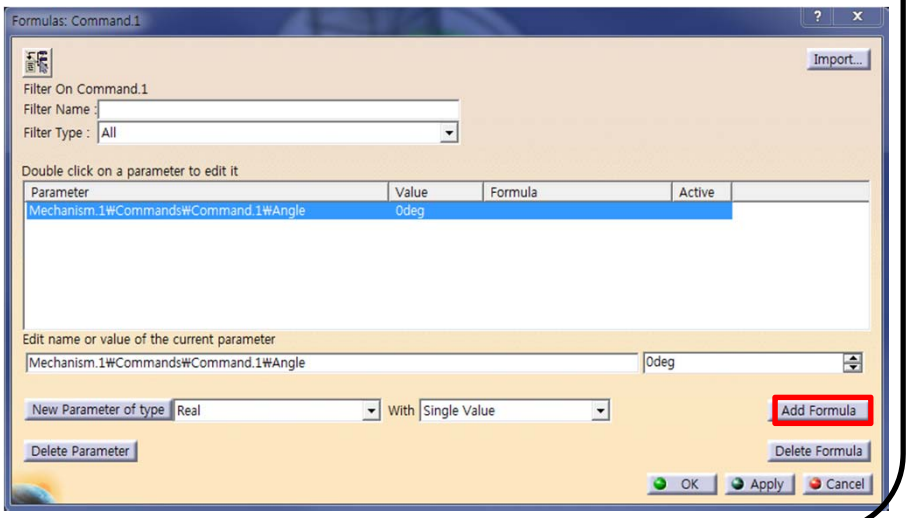
① 화면 하단의 툴바에서 Formula 선택

Formula 초기 화면



② 적용할 command를 더블클릭 후 Add Formula 클릭





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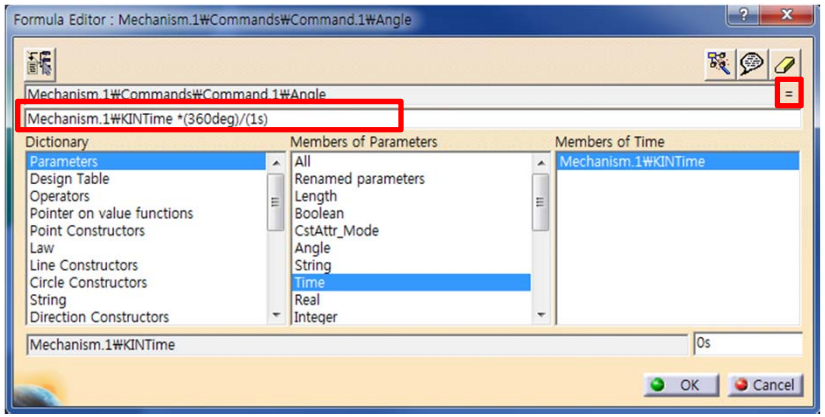
DMU KINEMATICS TOOLS

DMU Kinematics

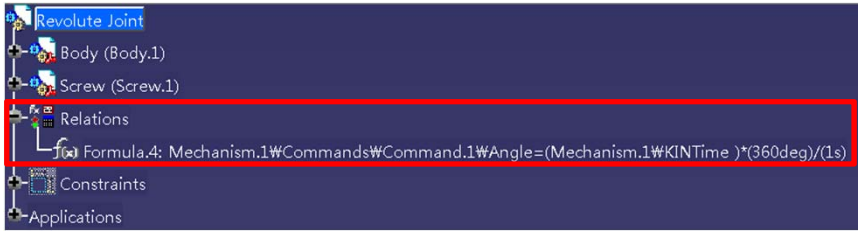
Simulation with Laws 

- 생성한 Formula를 기준으로 시뮬레이션 적용 (시간에 대한 변수 사용)

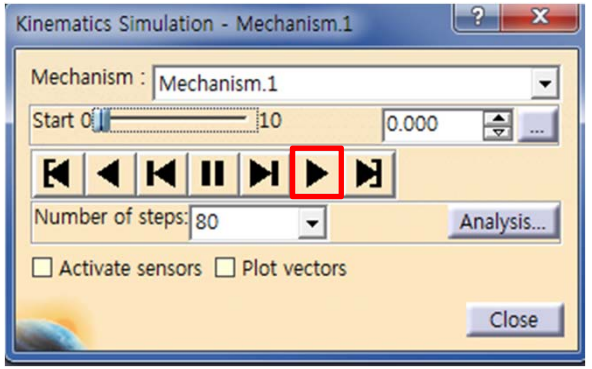
③ Parameters → Time → ₩KINTime 더블 클릭 후
수식 입력 후 Ok 클릭 < Mechanism.1₩KINTime *(360deg)/(1s) >

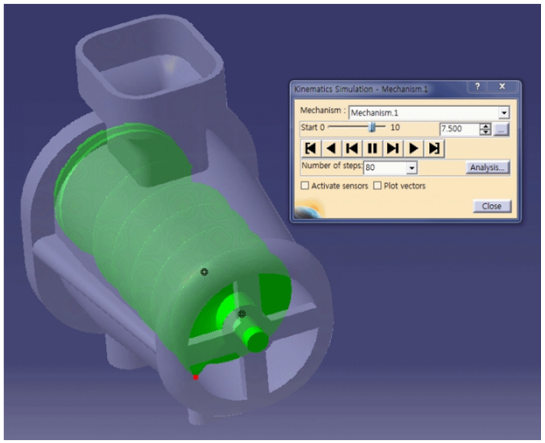


④ Formula 생성 확인



⑤  실행 후 적용됐는지 확인





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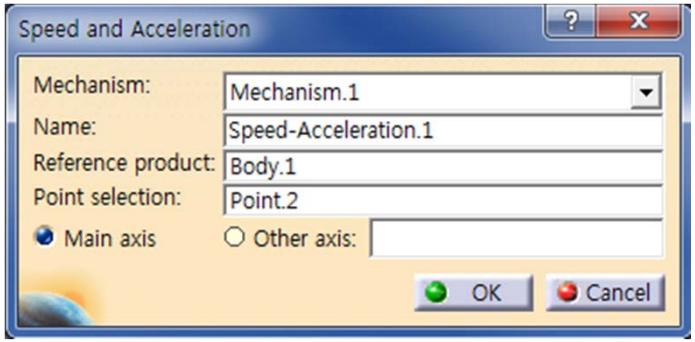
DMU KINEMATICS TOOLS

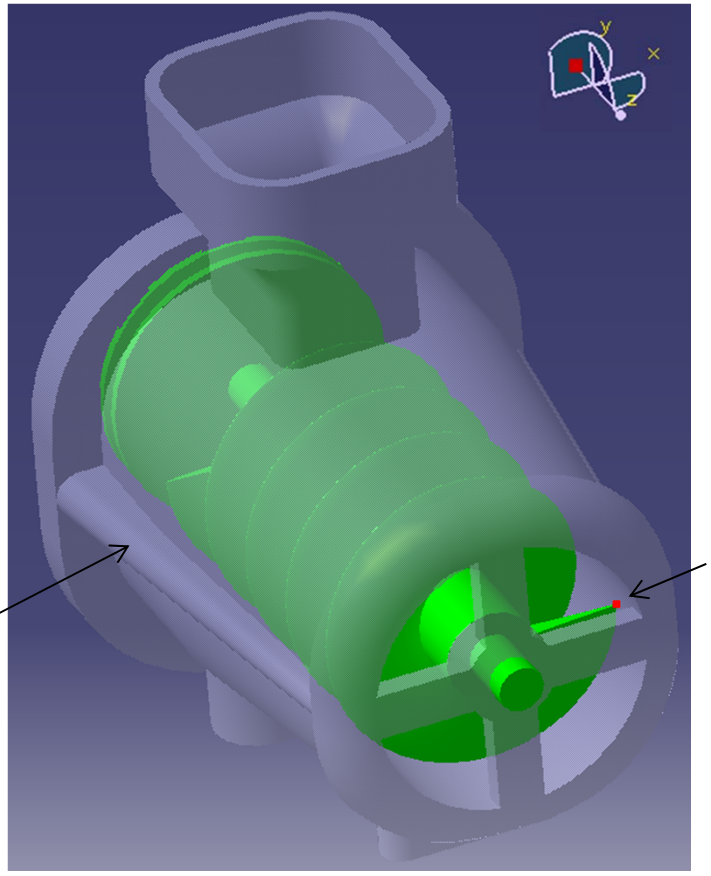
DMU Kinematics 

Speed and Acceleration 

- 특정 위치의 속도, 가속도 등을 확인함

①  실행 후 Reference product와 측정 Point 선택





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DMU KINEMATICS TOOLS

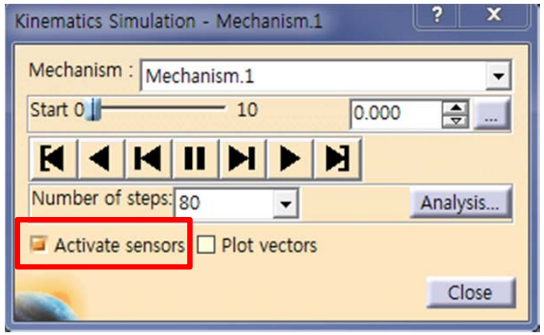
DMU Kinematics

Speed and Acceleration 

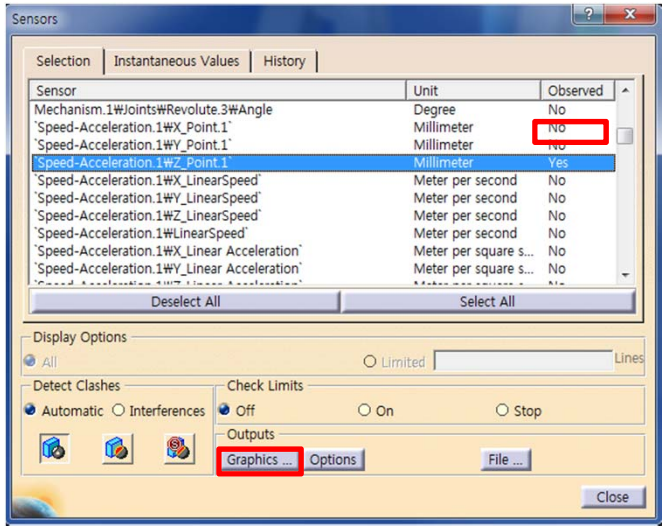
- 특정 위치의 속도, 가속도 등을 확인함

② Simulation with Laws 선택

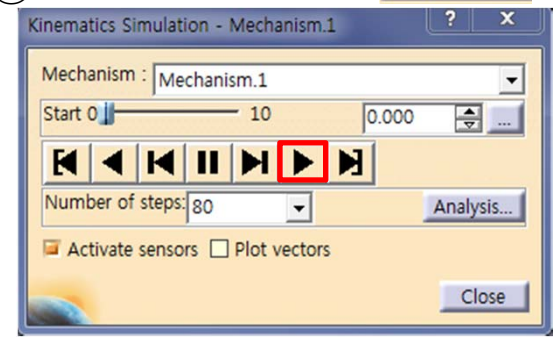
③ Activate sensors 선택



④ 측정하고자 하는 속도, 가속도 등을 활성화
(Observed의 No 클릭→Yes로 변환)
- EX) X_LinearSpeed, Z_Angular Acceleration, Z_Angular Speed



⑤ **시뮬레이션 실행 후** (4)의 Graphics ... 클릭



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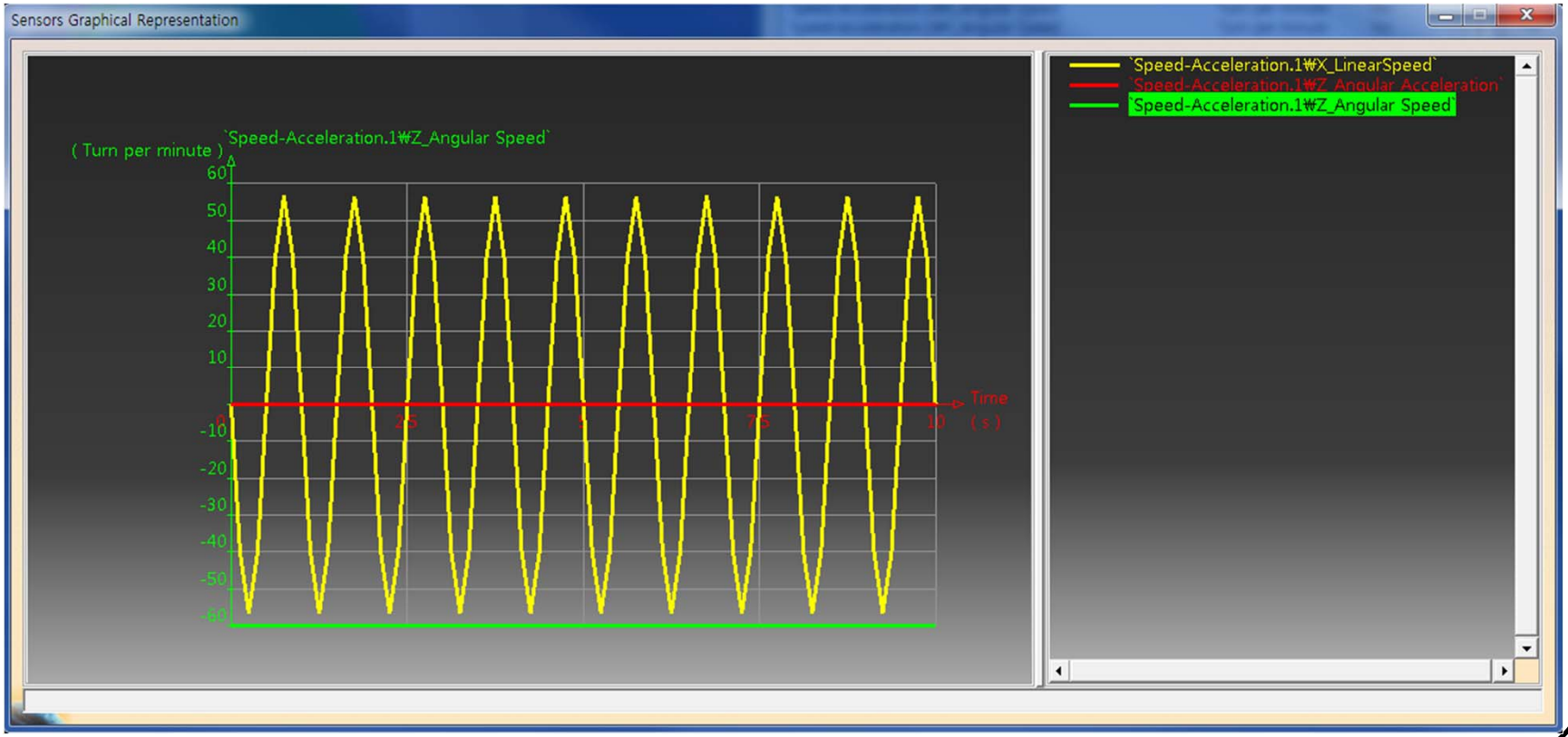
DMU KINEMATICS TOOLS

DMU Kinematics 

Speed and Acceleration 

- 특정 위치의 속도, 가속도 등을 확인함

⑥ 속도/가속도 결과



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CONTENTS

- ✓ 시작하기
- ✓ DMU Kinematics Tools
- ✓ **DMU Generic Animation**

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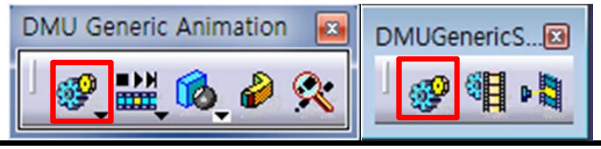
DMU KINEMATICS TOOLS

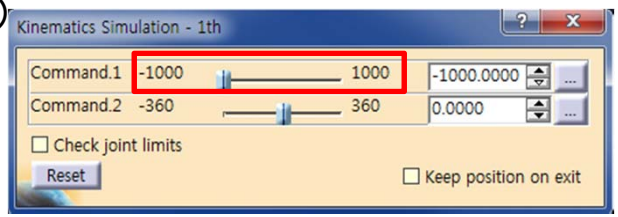
DMU Generic Animation



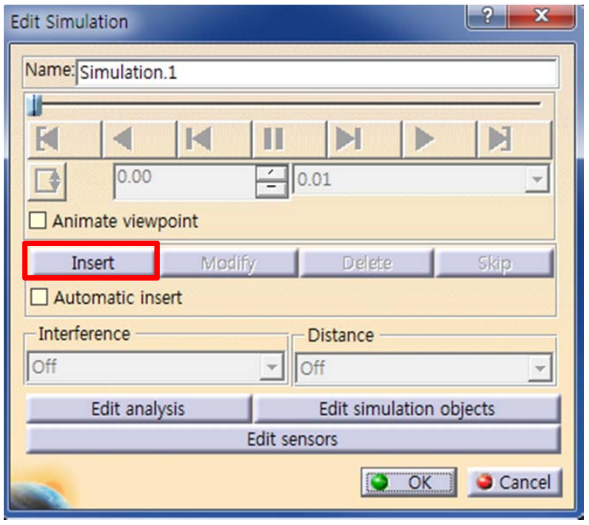
Simulation 

- 변화된 command 값 만큼 mechanism을 동작시킴

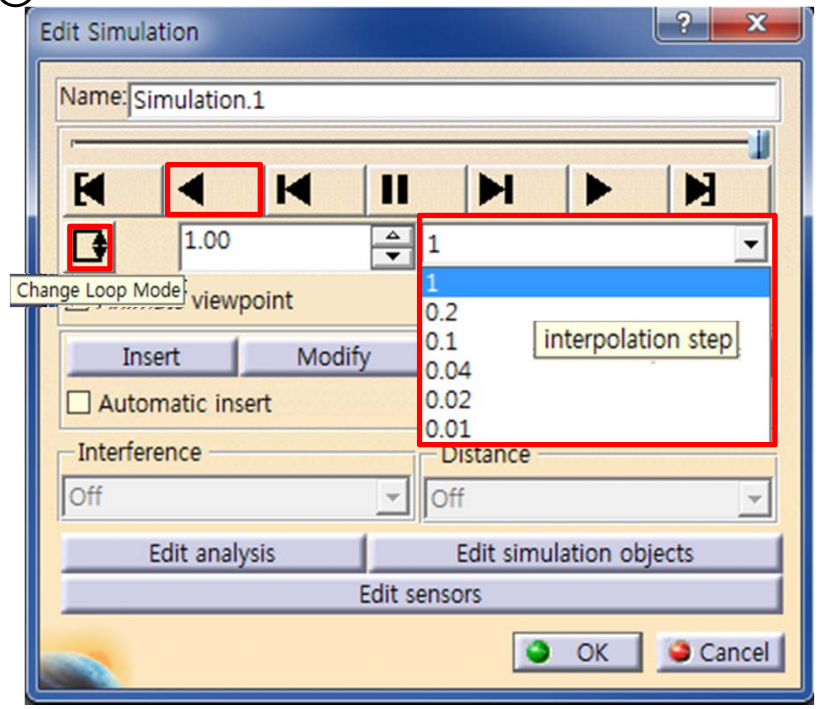
① 원하는 동작을 설정



② Insert



③ Loop Mode 및 Step 선택 후 재생



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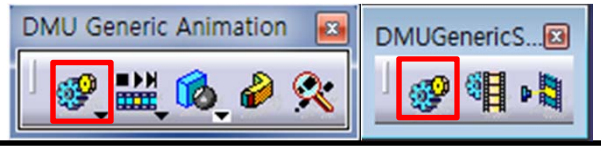
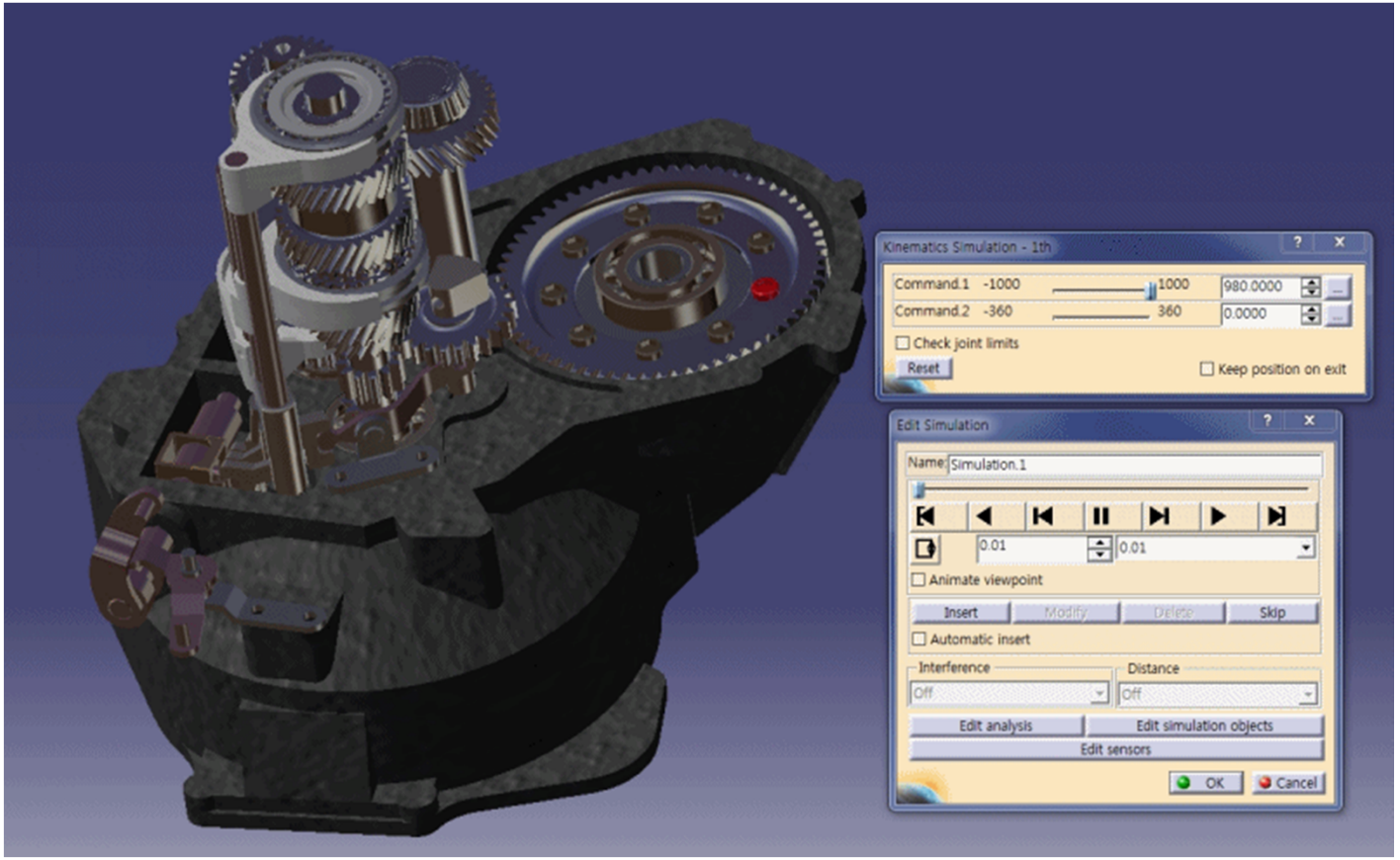
DMU KINEMATICS TOOLS

DMU Generic Animation



Simulation 

- 변화된 command 값 만큼 mechanism을 동작시킴



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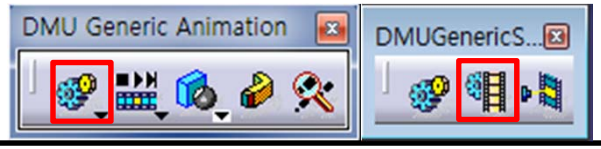
DMU KINEMATICS TOOLS

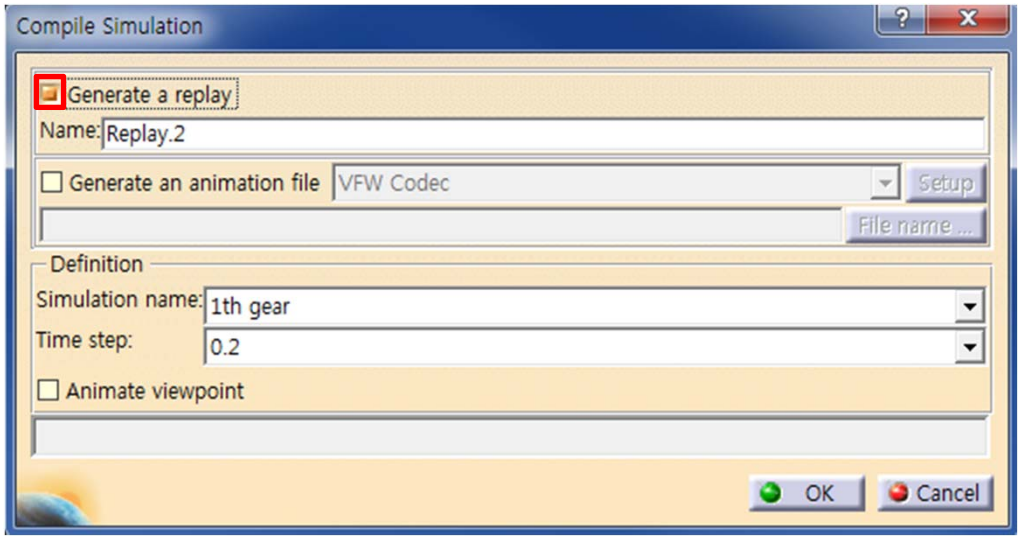
DMU Generic Animation



Compile Simulation

- 만들어진 시뮬레이션을 Replay 또는 동영상 파일로 저장함

Replay 생성



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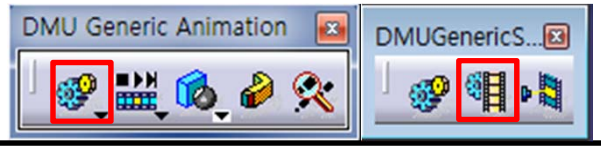
DMU KINEMATICS TOOLS

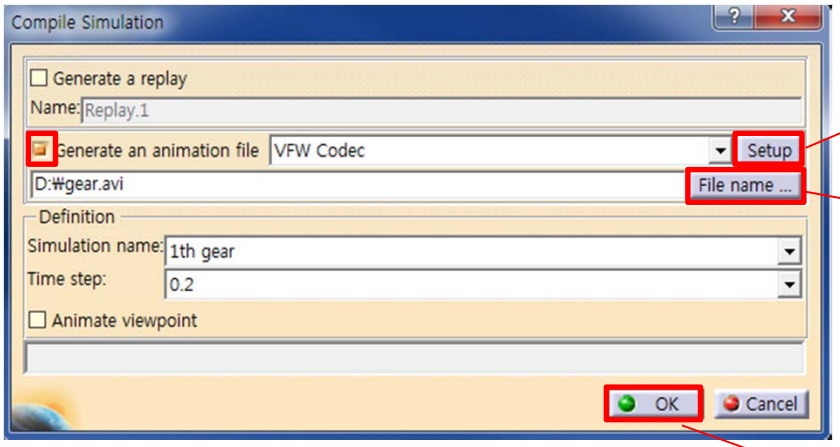
DMU Generic Animation



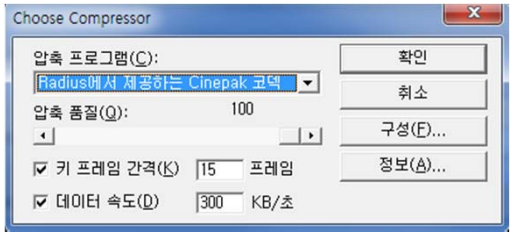
Compile Simulation 

- 만들어진 시뮬레이션을 Replay 또는 동영상 파일로 저장함

동영상 파일 생성



압축 코덱 /프레임 설정



파일 경로 설정

동영상 파일 생성

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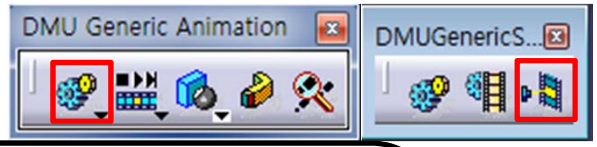
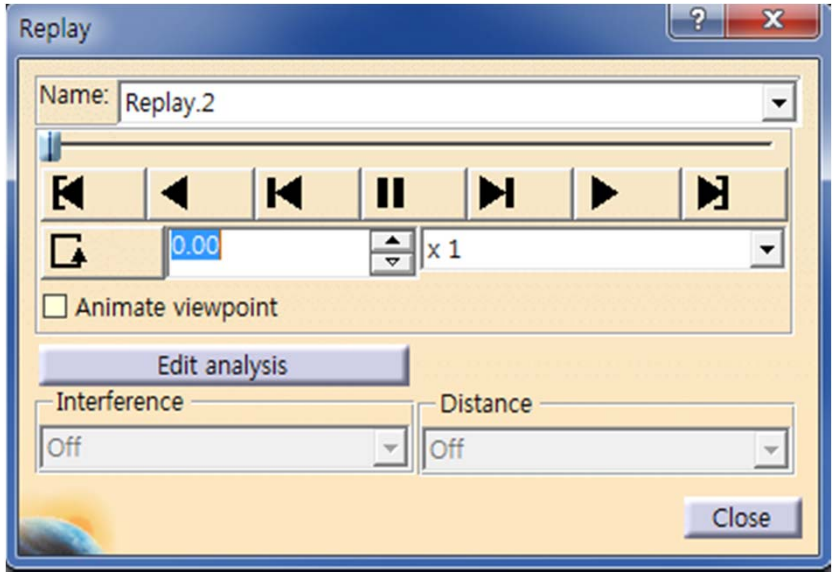
DMU KINEMATICS TOOLS

DMU Generic Animation



Replay 

- 만들어진 시뮬레이션의 Replay를 실행함



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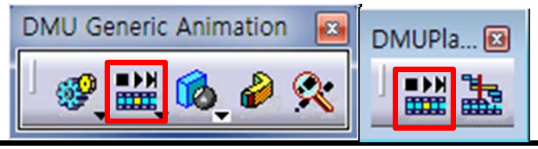
DMU KINEMATICS TOOLS

DMU Generic Animation

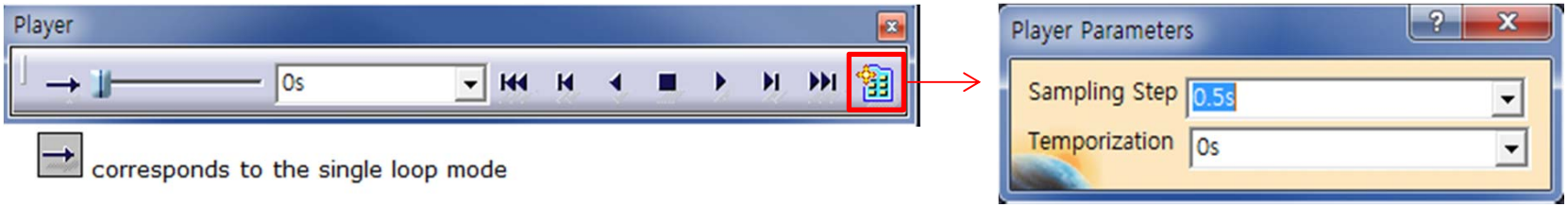


Simulation Player 

- 만들어진 simulation, replay, sequences를 실행시킴

Simulation 또는 Replay 선택

Step 입력



 corresponds to the single loop mode

 corresponds to the one way loop mode

 corresponds to the return simulation mode.

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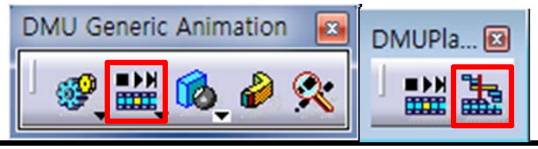
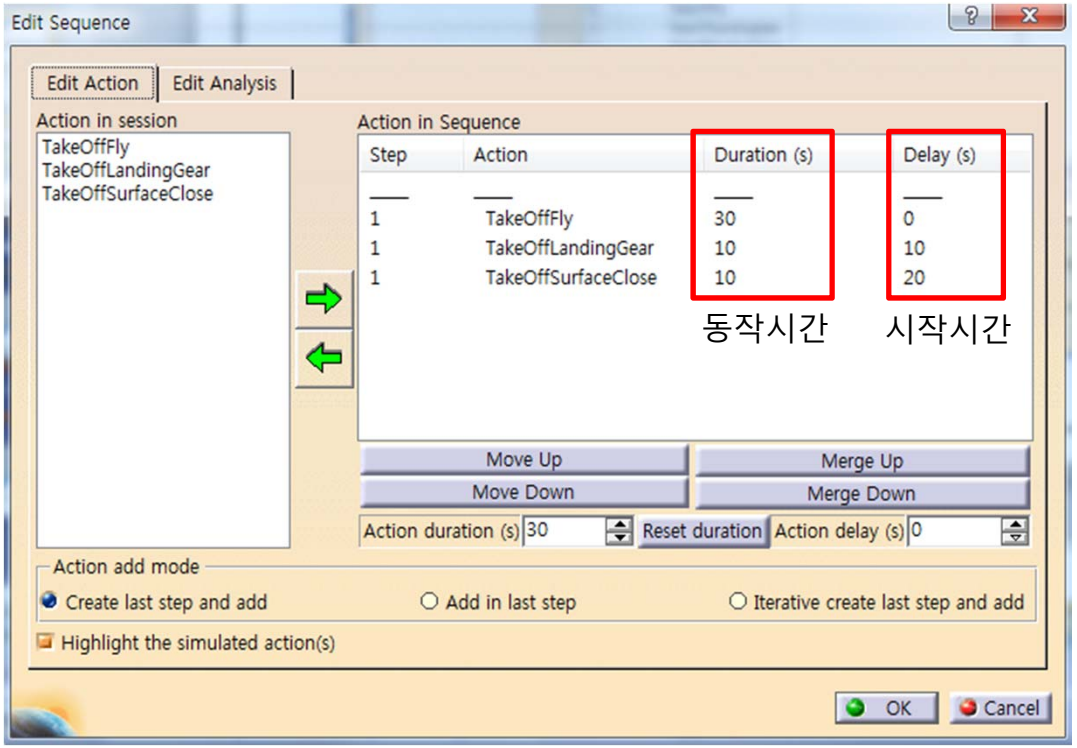
DMU KINEMATICS TOOLS

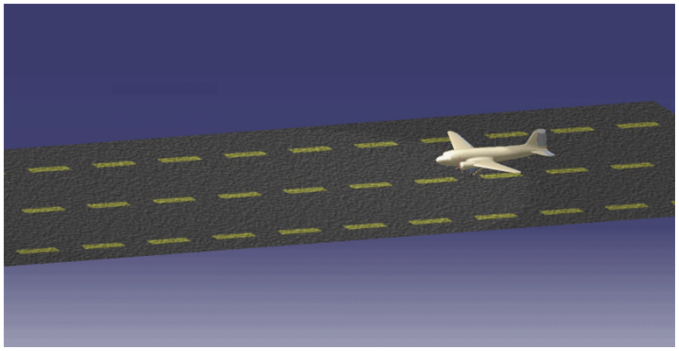
DMU Generic Animation

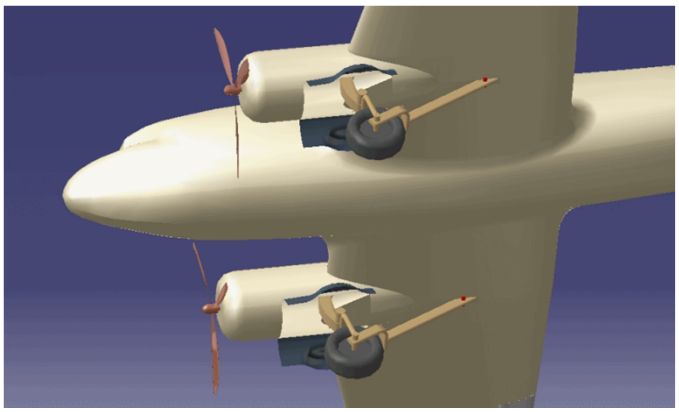


Edit Sequence 

- 만들어진 시뮬레이션들의 시간을 조절하여 하나의 시뮬레이션으로 구성함







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DMU KINEMATICS TOOLS

DMU Generic Animation

Clash Mode

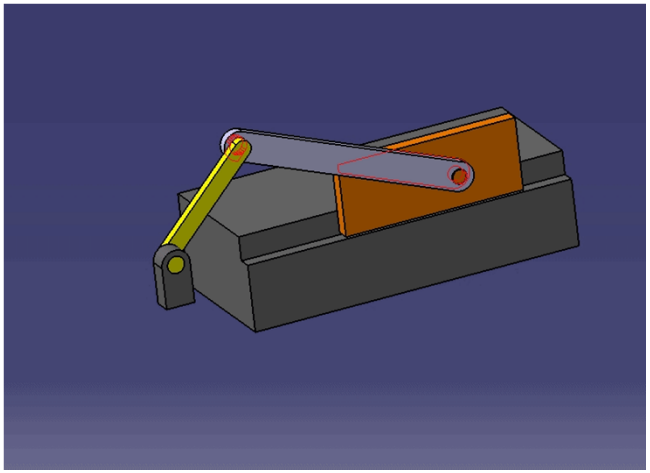
- 시뮬레이션을 실행할 때 간섭여부를 확인함

Deactivates automatic clash detection for simulation

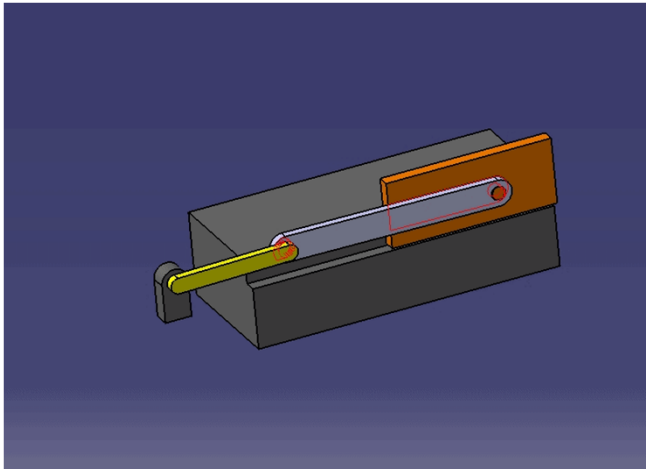
Activates automatic clash detection for simulation

Activates automatic clash detection stop mode for simulation

기존의 Slider-Crank 모델



간섭이 일어나는 모델



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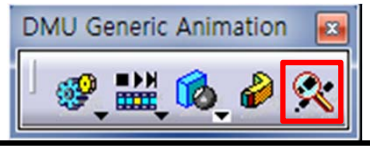
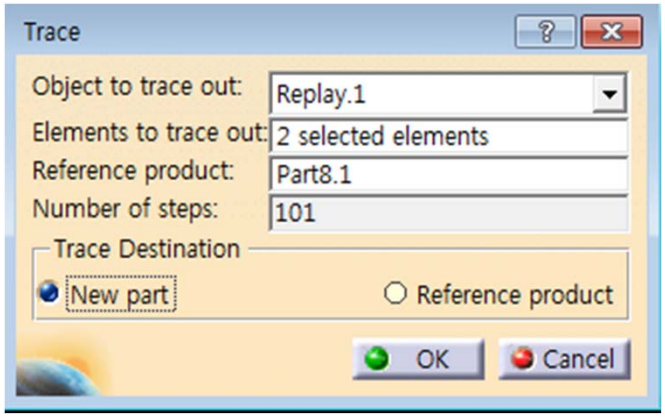
DMU KINEMATICS TOOLS

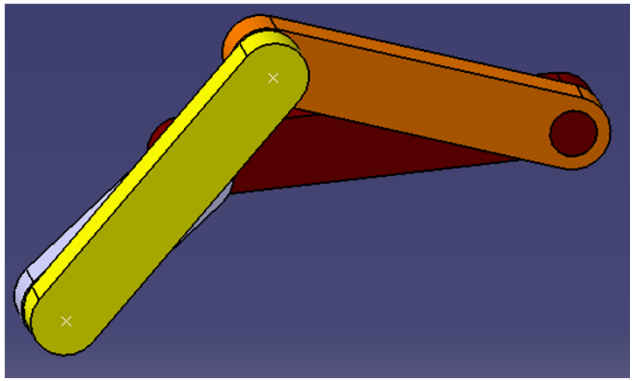
DMU Generic Animation

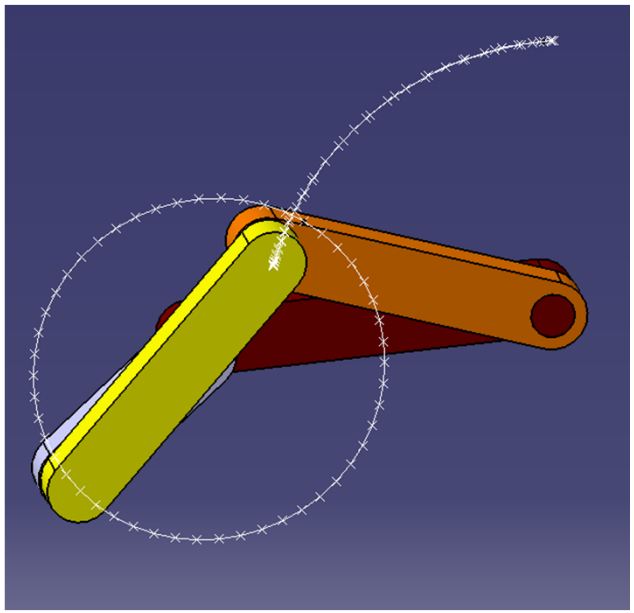


Trace

- 선택한 elements의 이동을 replay를 기준으로 표시함.







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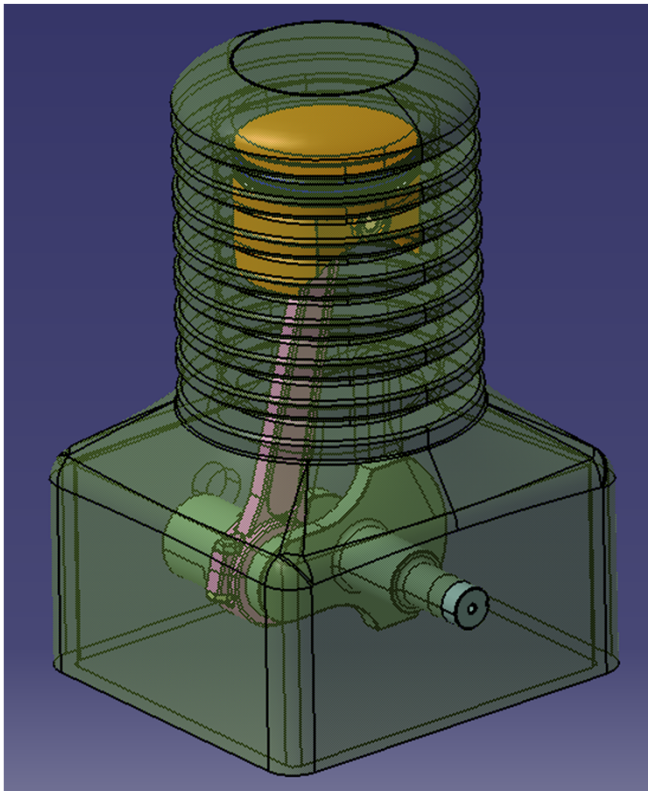
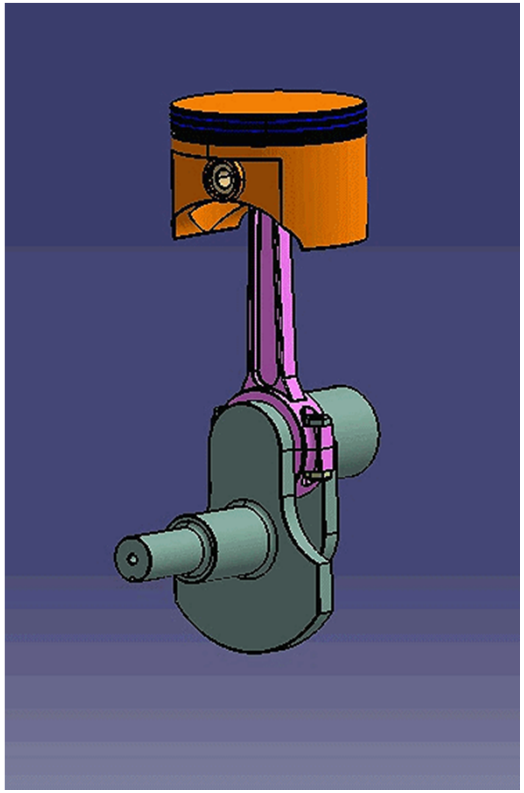
실습 과제

Assembly Design의 Piston 모델을 이용하여 아래와 같이 DMU Kinematics 작업 진행하기

(Simulation 동영상 + Product + Part 파일들 압축하여 업로드)





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