

# The pedaling cyclist

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# Background



Milliseconds determine victories in fierce cycling competitions

# Background

- ▶ CFD simulations and wind tunnel testing enables aerodynamic optimization



<https://www.youtube.com/watch?v=8RH0en-9iIg>

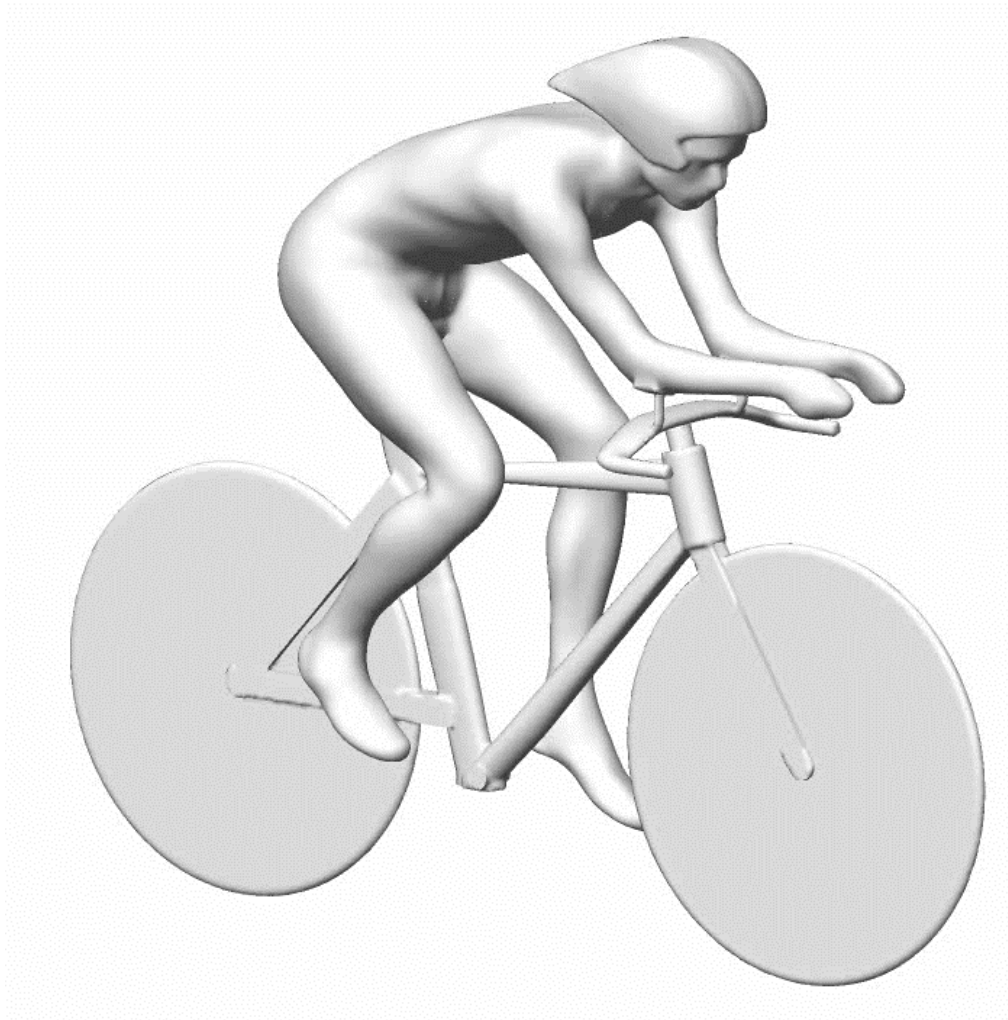
# Background

- ▶ Cyclist is constantly pedaling
- ▶ Drag depends on the leg motion



<https://www.youtube.com/watch?v=8RH0en-9iTg>

# Challenge



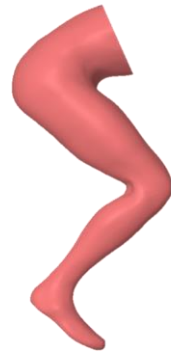
- ▶ Transfer movement to CFD mesh
- ▶ Preserve mesh quality

# Method

DEFORMATION OF  
LEG SURFACE

KEYFRAME-BASED  
MESH MORPHING

RUN SIMULATION



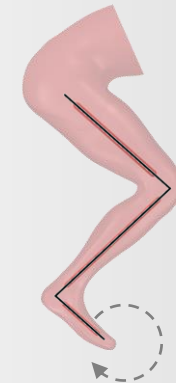
Create muscle  
region



Create bone  
structure



Create contact  
regions



FEA to obtain  
deformations

# Method

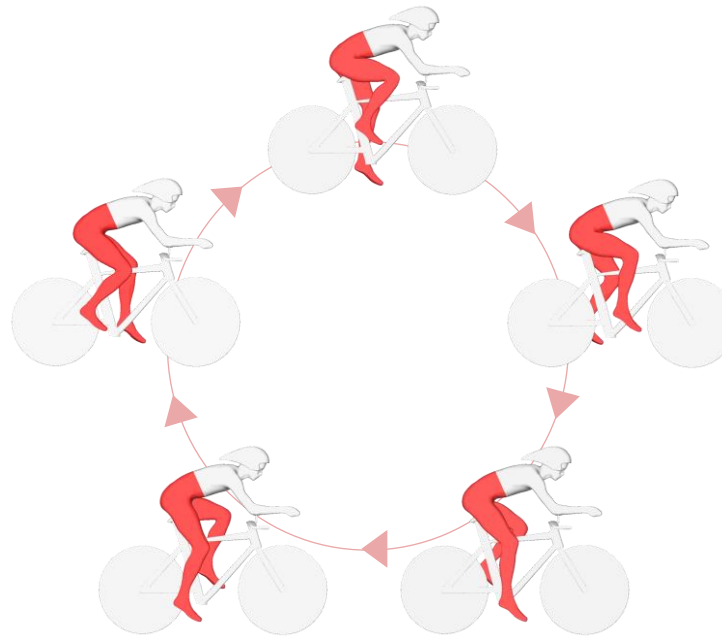
DEFORMATION OF  
LEG SURFACE

KEYFRAME-BASED  
MESH MORPHING

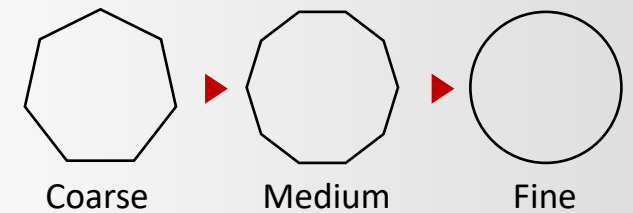
RUN SIMULATION

RBF Morphing solutions  
are constructed for a finite  
number of keyframes

Mesh is linearly  
interpolated between  
keyframes



Fine discretization enables to  
capture non-linear motion



# Method

DEFORMATION OF  
LEG SURFACE

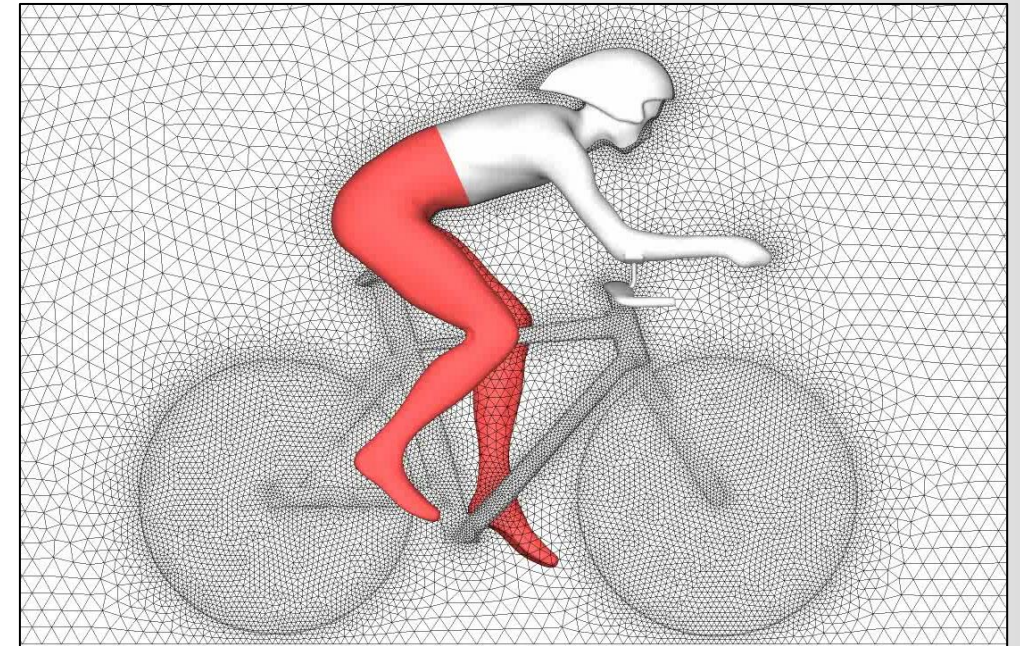
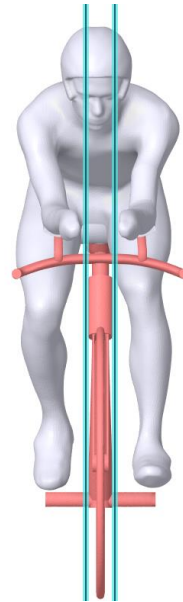


KEYFRAME-BASED  
MESH MORPHING



RUN SIMULATION

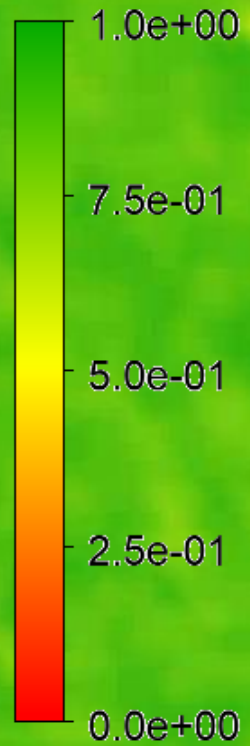
Sliding planes allow to  
morph each side  
independently

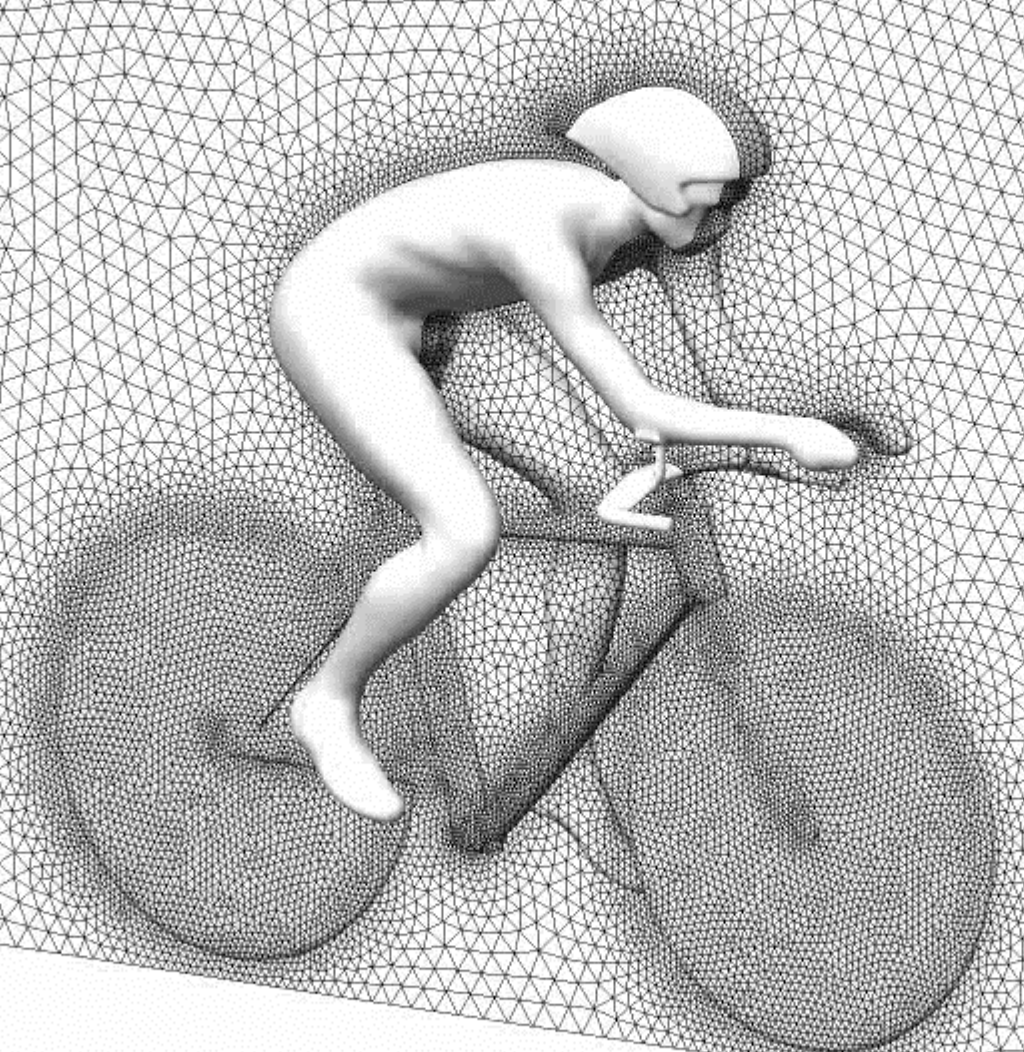


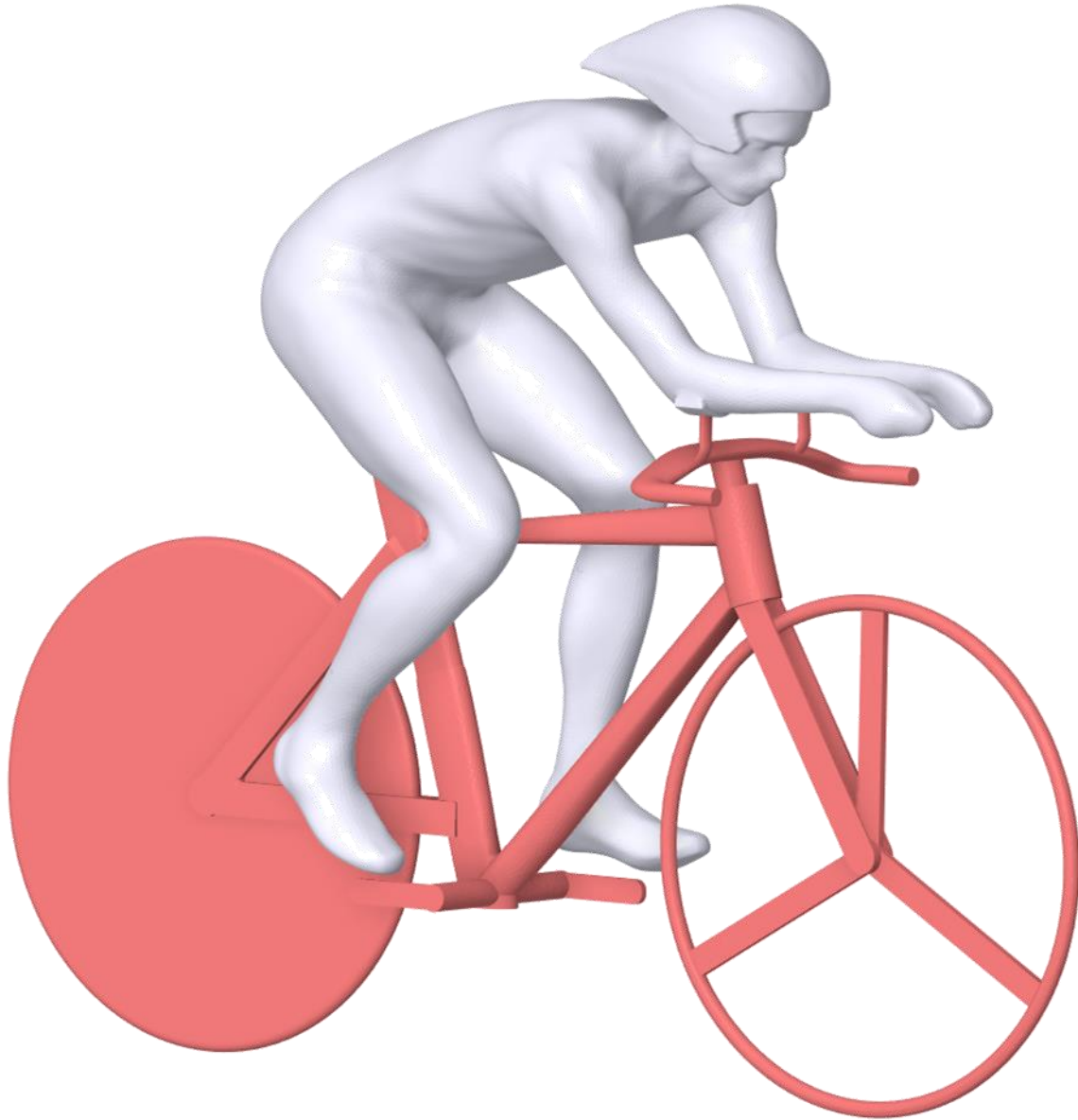


# Cell Quality

Orthogonal quality







Fast morphing

Versatile

Preserve quality



