我们用双曲正弦函数来拟合收集而来的power curve的数据点，发现双曲正弦函数的拟合效果非常好。我们结合双曲正弦函数与斯基巴能量平衡模型量化了我们的车手的生物能量模型，参考双曲正弦函数对不同类型及不同性别车手的power curve拟合得到的参数，定义了time trial specialist和sprinter了的power curve，并根据power curve得到FTP（全称）值和Critical Power（CP），进而定义了他们在斯基巴能量平衡模型中的参数，从而得到他们的power profile。

对于第二个问题，我们在第一问的能量模型的基础上，建立了我们的能量分配模型，我们利用sigmoid函数非线性和值域在0~1之间的特点，将赛道参数与时间的线性组合的结果传入sigmoid进行非线性化，并将得到的结果作为最大输出功率的衰减因子。我们利用粒子群算法，根据不同赛道进行PDM模型的参数优化，并将优化过的PDM模型依次应用于不同赛道。

We used hyperbolic sine function to fit the data of the collected power curves and found that the hyperbolic sine function was a very good fit. We combined the hyperbolic sine function with the Skiba energy balance model to quantify the EnergyCM of our riders, defined the time trial specialist and sprinter's power curve by referring to the parameters obtained by fitting the hyperbolic sine function to the power curve of different types and gender of riders, and obtained the FTP (allometric) value and Critical Power (CP) value based on the power The FTP (Full Name) value and Critical Power (CP) are obtained from the power curve, and then their parameters in the Skiba energy balance model are defined to get their power profile.

For Task 2, we built our Power Distribution Model (PDM) based on the energy model from Task 1. We used the characteristics of the sigmoid function being nonlinear and having a value domain between 0 and 1 to pass the results of the linear combination of the circuit parameters (including aaaa) and time into the sigmoid for nonlinearization, and used the obtained results as the decay factor of the maximum output power. Then, to verify the feasibility of PDM, we set up a Kinematic Bicycle Model, Circuit Models, and Energy Consumption Model in Simulink for joint simulation. We analyzed the force and motion of the bicycle and listed the differential equations of the bicycle motion according to Newton Law 2 \cite. In addition, we collected and post-processed the data of three different circuits to obtain some characteristics of them. We then combined these four Models to form a closed-loop control chain/cite. We used the PSO algorithm to optimize the parameters of the closed-loop control chain for the three circuits and obtained three different sets of parameters for the three different tracks. The final laptime of Time Trial Specialist we obtained were 34.25 min for Fuji track, uci flanders, and self-invented track. Meanwhile The final laptime of Sprinter were Fuji track, uci track, and self-invented track.

For Task 3, taking the uci track as an example, we take the effect of wind speed, wind direction, altitude and temperature into account. For wind speed and wind direction, we further improved the Kinematic Bicycle Model based on the model from Task 2 by introducing two variables: wind speed and wind direction and the angle between the direction of travel, and introducing the effect of wind speed in the direction of travel into the air resistance, with the final result

m 0 to 20kph and the Lap time increased from 62.47 to 66.53

Meanwhile, when the wind direction is changed by 25%, the lap time will change by 1.7% on average.

In terms of altitude and air temperature, the air density can be obtained from the ideal gas equation of state\cite, and the air density can be directly reflected in the air resistance.For every 1000m increase in Altitude, the lap time increases by an average of 2.06 minutes.The effect of temperature on lap time is on average 0.88% for every 1%change in temperature from 273.15K.

For Task 4, taking the uci track as an example, we further improve the Power Distribution Model based on previous tasks by introducing a uniformly distributed random number/cite and converting it to the power output of the athlete/cite to examine the robustness and sensitivity of the overall motion system. The final result is no impact

For Task 5, taking the uci track as an example we searched for information about team road cycling time trials and summarized two important variables, i.e., alternate wind break time/cite and final sprint distance/cite, and added them into our model to extend the model to team time trials, and conducted joint simulation iterations by PSO algorithm to find the optimal values of the parameters. The final result is that the wind break time for the four sprinters is 25s, the other two alternate wind break time is 40s, and the final sprint distance is 40km, and the total time of the team race will be about 530 seconds faster compared to the individual time trial race.