### 已知渡河总时长不变,则有

$$rac{S_1}{V*\coslpha_1}+rac{S_2}{V*\coslpha_2}+\ldots+rac{S_n}{V*\coslpha_n}=T$$

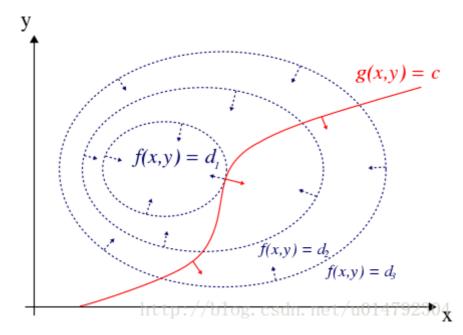
# 要求 dH 如下式的极小值

$$dH = rac{S_1}{V*\coslpha_1}*\left(V*sinlpha_1+V_1
ight) + rac{S_2}{V*\coslpha_2}*\left(V*sinlpha_2+V_2
ight) + \ldots + rac{S_n}{V*\coslpha_n}*\left(V*sinlpha_n+V_n
ight)$$

# 可看做是如下的优化问题

 $min_x f(x)$ 

s.t. g(**x**)=0



$$T(n) = \frac{S_1}{V_1 * \cos \alpha_1} + \frac{S_2}{V_2 * \cos \alpha_2} + \ldots + \frac{S_n}{V_n * \cos \alpha_n 1}$$

## 该极值点处满足

$$\left\{egin{array}{l} \bigtriangledown dH = \lambda \bigtriangledown T(n), \ T(n) = T \end{array}
ight.$$

# 求梯度如下

$$\left\{egin{array}{l} rac{S_1 \sin lpha_1 \lambda}{V \cos lpha_1^2} = rac{S_1 (V + V_1 * \sin lpha_1)}{V \cos^2 lpha_1}, \ rac{S_2 \sin lpha_2 \lambda}{V \cos lpha_2^2} = rac{S_2 (V + V_2 * \sin lpha_2)}{V \cos^2 lpha_2}, \ rac{S_n \sin lpha_n \lambda}{V \cos lpha_n^2} = rac{S_n (V + V_n * \sin lpha_n)}{V \cos^2 lpha_n}, \end{array}
ight.$$

# 约去公因式,可得

$$\left\{egin{array}{l} \sinlpha_1=rac{V}{\lambda-V_1},\ \sinlpha_2=rac{V}{\lambda-V_2},\ \ldots,\ \sinlpha_n=rac{V}{\lambda-V_n} \end{array}
ight.$$

带入时间不变的等式, $解得 \lambda$ 

进而求解角度