Supplemental method

Mathematical modelling. Two ODEs-based deterministic models were developed for better understanding principles of the AdpA controlled promoter system. The integration of ODEs was performed with the *ode45* function in matlab environment (R2014b).

The first model is for the closed negative-feedback loop, which is composed by three differential equations:

$$\frac{dP_{adpA}}{dt} = P_{adpA} \text{ basic} - a \times P_{adpA} \times C_{\text{AdpA}} \tag{1}$$

$$\frac{dC_{AdpA}}{dt} = d_{\text{AdpA}} \times C_{\text{AdpA}} + b \times P_{adpA} \times C_{\text{AdpA}} \tag{2}$$

$$\frac{dC_{ActII-4}}{dt} = d_{\text{ActII-4}} \times C_{\text{ActII-4}} + c \times C_{\text{AdpA}} \tag{3}$$

Where P_{adpA} represents the *adpA* promoter strength, P_{adpA} basic is the basic (or background) strength of *adpA* promoter, C_{AdpA} and $C_{\text{ActII-4}}$ represent the AdpA and ActII-4 amounts, respectively. d_{AdpA} and $d_{\text{ActII-4}}$ represent the degradation factor of AdpA and ActII-4, respectively. a, b are P_{adpA}-AdpA interaction parameters, c is ActII-4-AdpA interaction parameter. For simulation, the initial values of P_{adpA}, C_{AdpA} and $C_{\text{ActII-4}}$ is all set to 10. a, b, and c are set to 0.01, 0.02, 0.5, respectively. Both d_{AdpA} and $d_{\text{ActII-4}}$ are set to -1. All parameters are unitless. The simulating time-scale is set to 0~25.

The second model is for the linear system temporally caused by high S^0/AdpA, which is composed by two equations:

$$\frac{dC_{AdpA}}{dt} = d_{\text{AdpA}} \times C_{\text{AdpA}} + b \times \frac{S^0}{AdpA} \tag{4}$$

$$\frac{dC_{ActII-4}}{dt} = d_{\text{ActII-4}} \times C_{\text{ActII-4}} + d \div \frac{S^0}{AdpA} \tag{5}$$

Where $\frac{S^0}{AdpA}$ represents the S^0/AdpA ratio, b represents the positive effect of S^0/AdpA

on C_{adpA}, d represents the negative effect of $S^0/AdpA$ on $C_{actII-4}$. For simulation, the initial values of C_{AdpA} and $C_{ActII-4}$ are both set to 10. $\frac{S^0}{AdpA}$ is set to 50, both b and d are set to 1, both d_{AdpA} and $d_{ActII-4}$ are set to -1. All parameters are unitless. The simulating time-scale is set to 0~25.