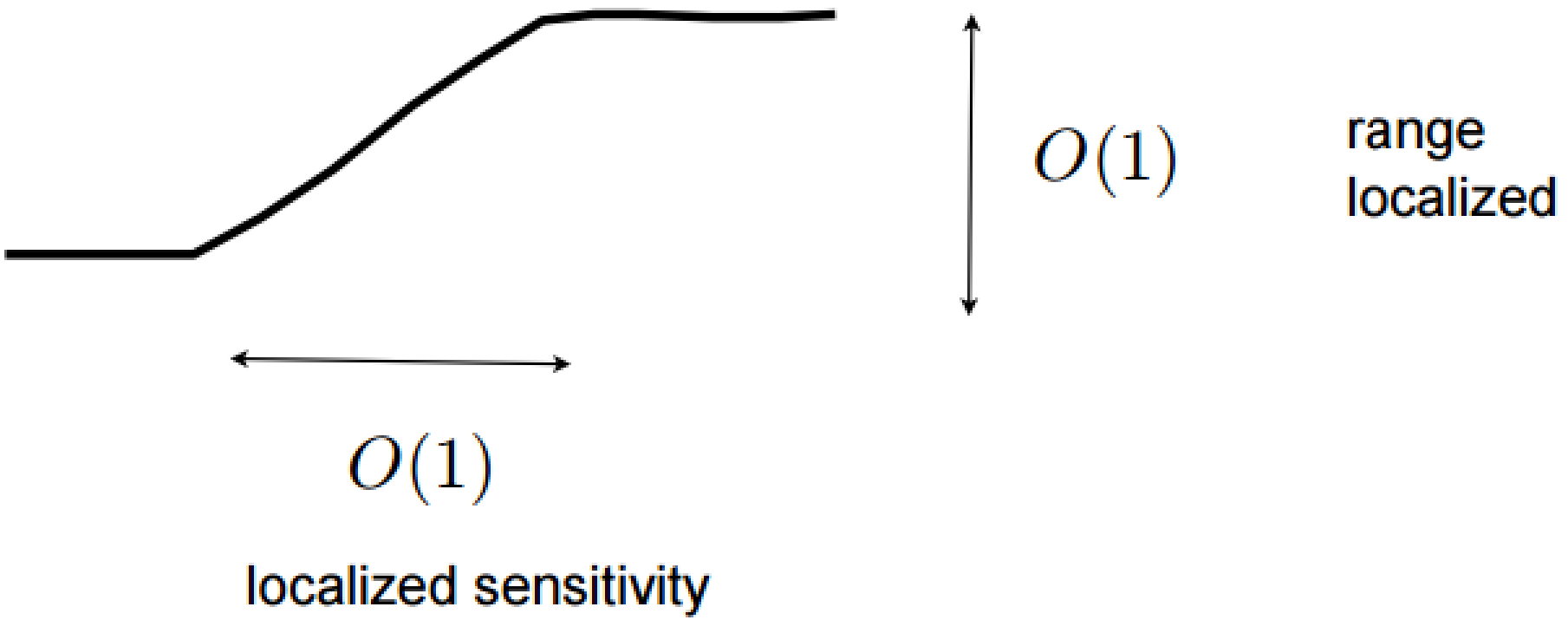
# Positive and negative feedback

Slides courtesy of prof. Rodolphe Sepulchre

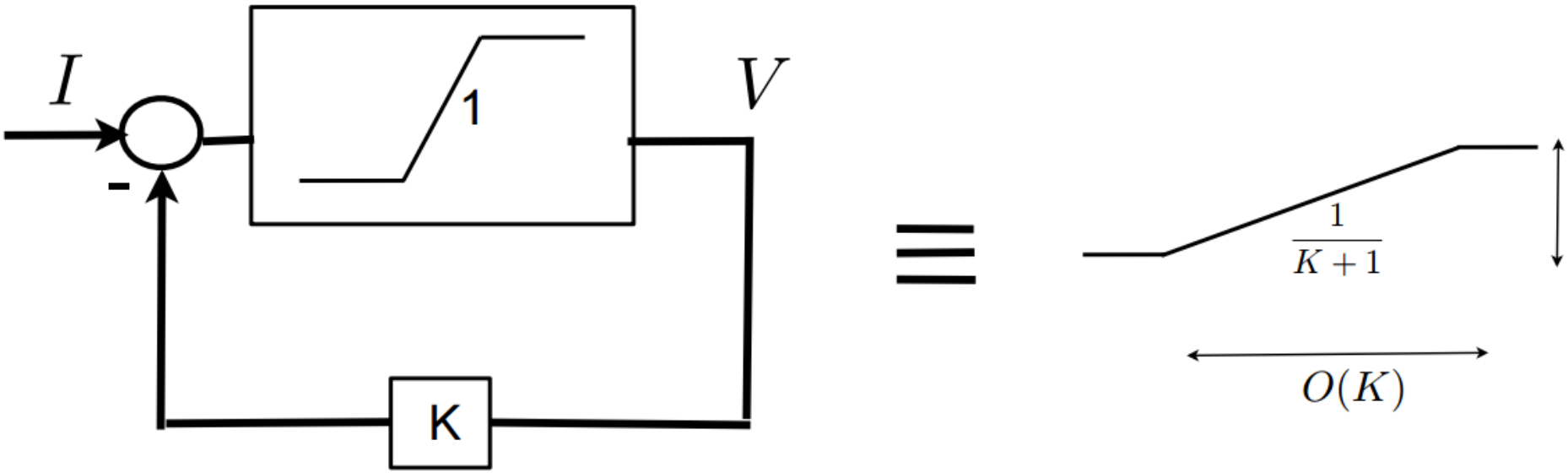
July 9, 2015

# Range-localized sensitivity is a nonlinear behavior

$$V = sat(I)$$



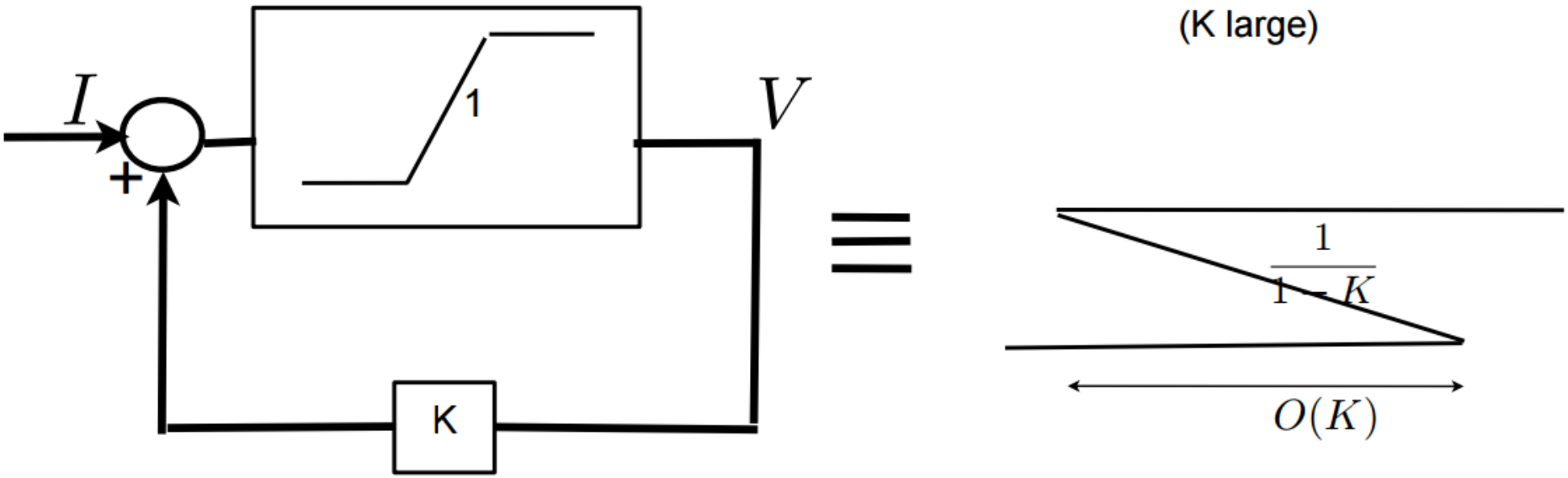
# Black principle: negative feedback 'linearizes'




$$V = sat_1(I - KV) \equiv V = sat_{\frac{1}{1+K}}(I)$$

Sensitivity domain is spread by negative feedback
(The essence of control theory)

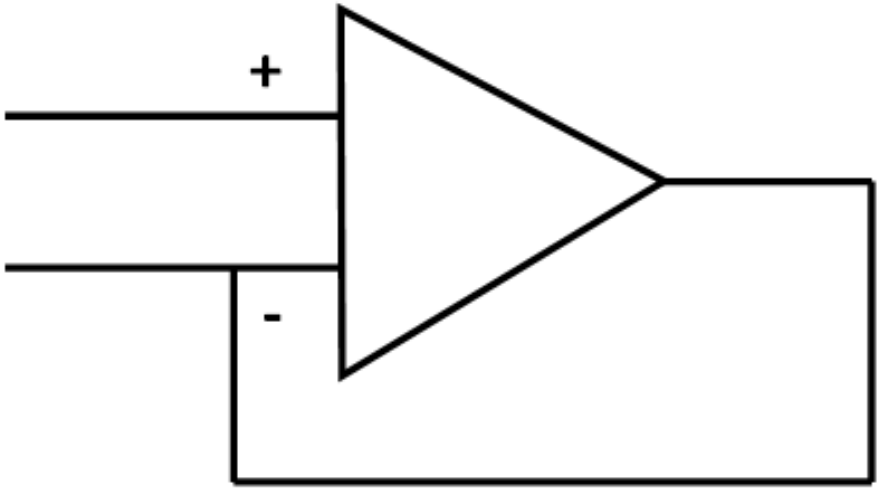
# Black principle: positive feedback 'quantizes'



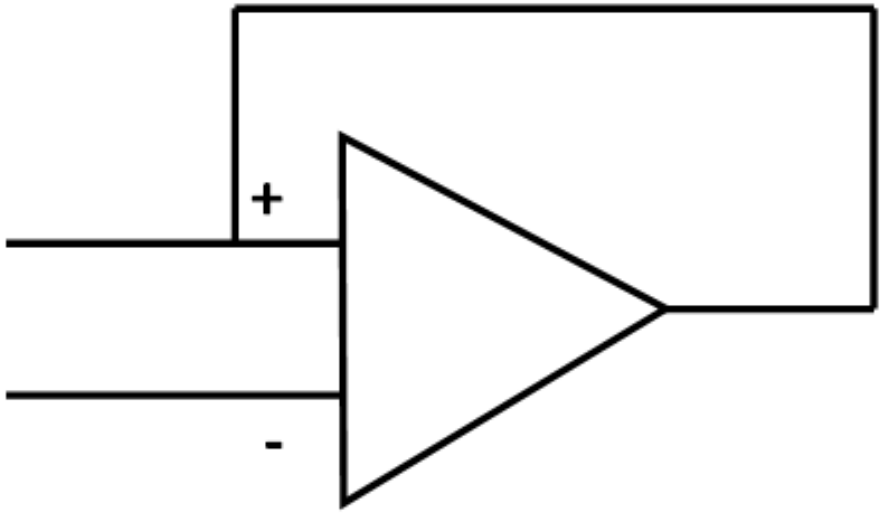

$$V = sat_1(I + KV) \equiv V = \begin{cases} +1 & I \geq -1 - K \\ \text{-1} & I \leq K - 1 \end{cases}$$

Sensitivity domain is spread by negative feedback

# Black feedback principle

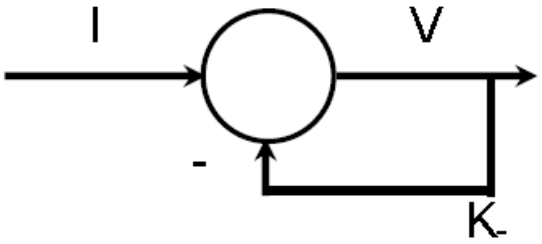


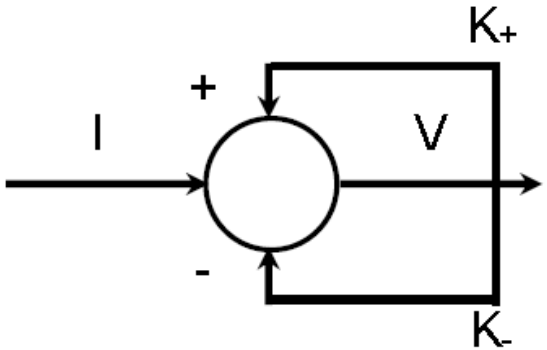

1. Negative feedback linearizes
2. Continuous behavior
3. Analog technology
4. Output primarily reflects the input
5. Loops enhance or amplify the changes between input and output

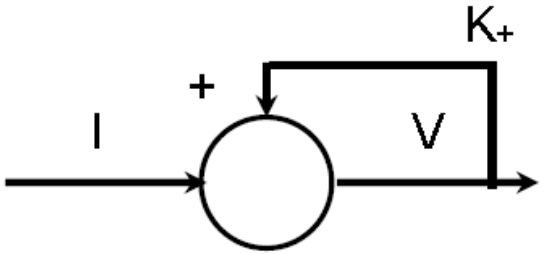



1. Positive feedback quantizes
2. On-Off behavior
3. Digital Technology
4. Output primarily reflects memory of the past
5. Loops tend to dampen or buffer the changes between input and output

# Balanced feedback 'localizes'




*'linear'*

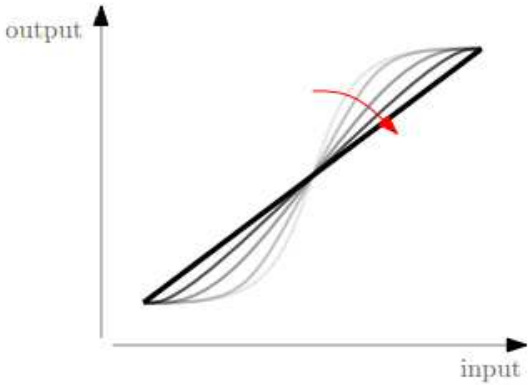
*'localized'*

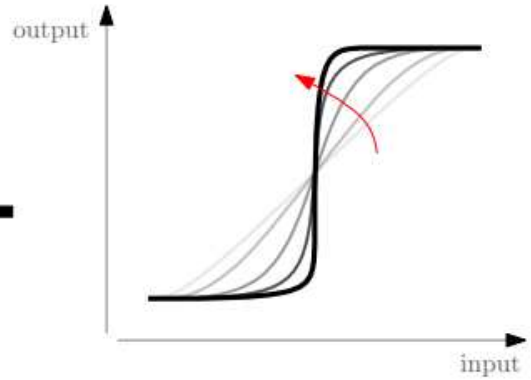
*'memory'*

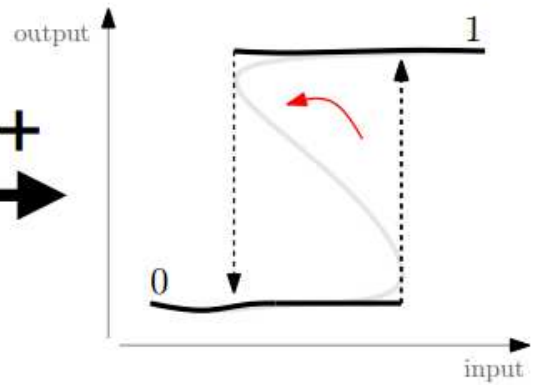
$|k|$*large*

$|k|$*small*

$|k|$*large*



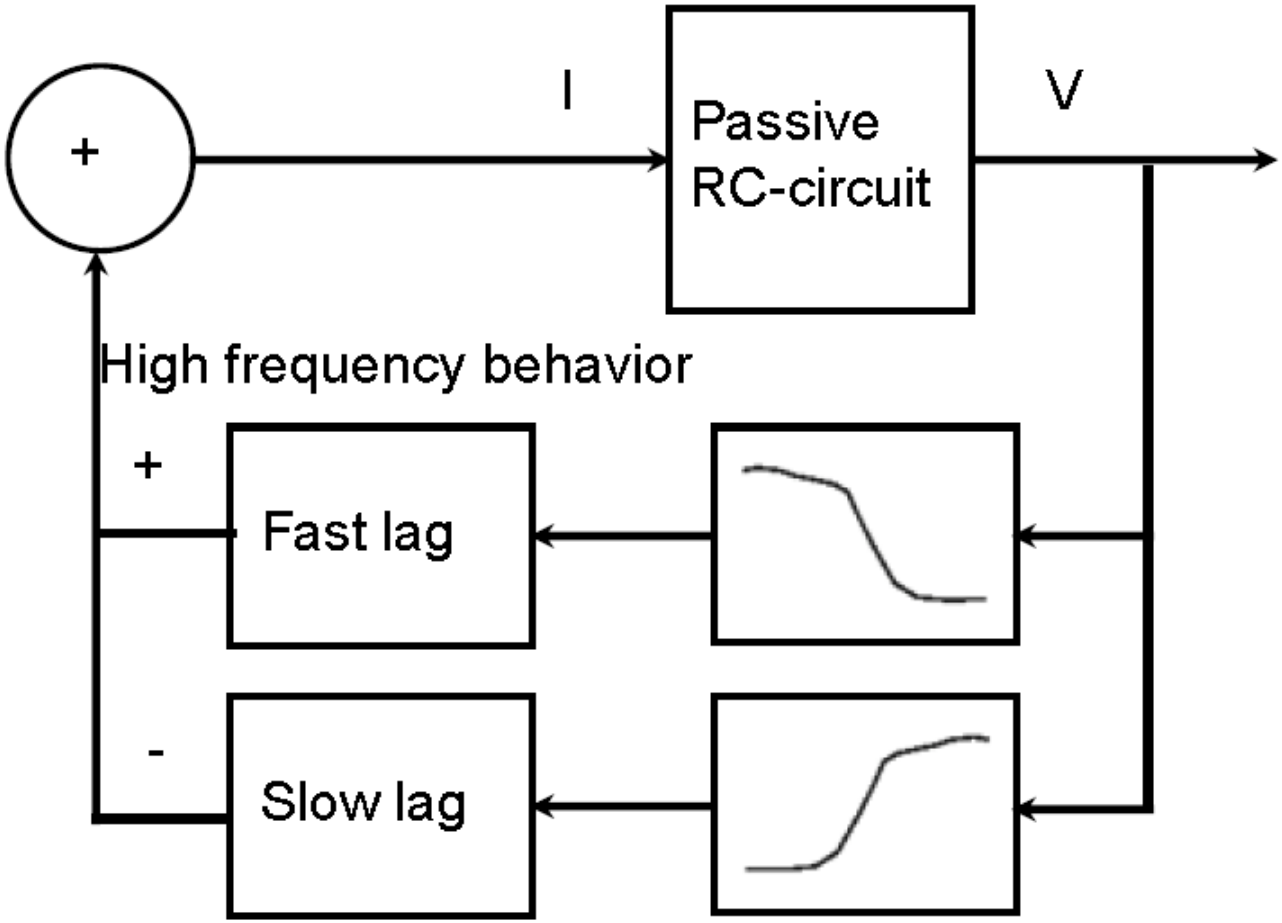




$$\overleftrightarrow{O(k)}$$

$$k \approx K_+ - K_-$$

# Robust space + time localization by feedback




Low frequency behavior

Necessary localization in same frequency range!