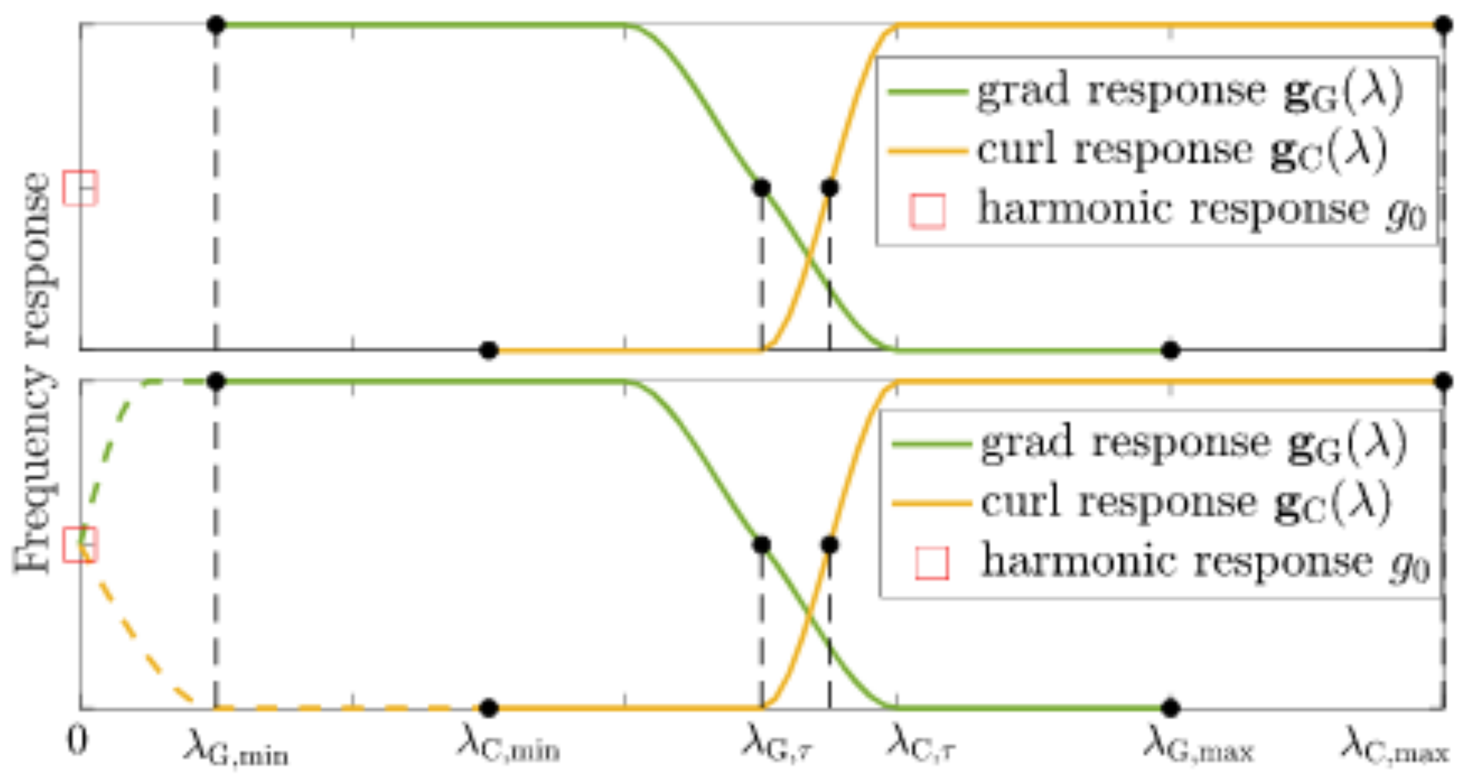
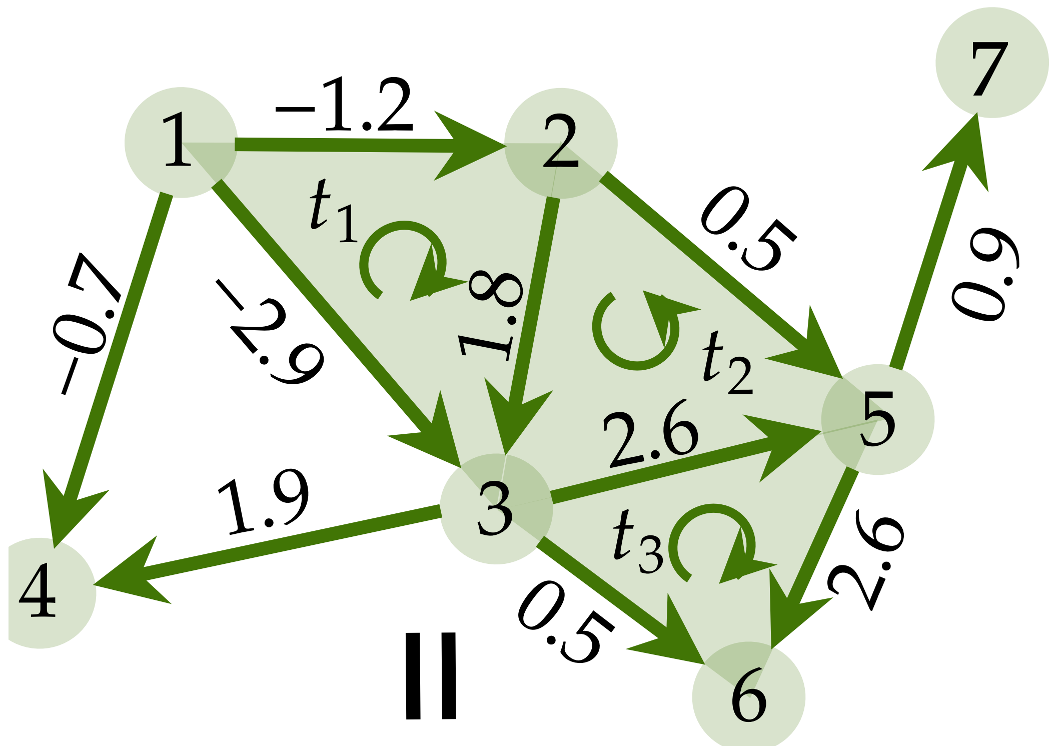
Edge Convolutions on SCs

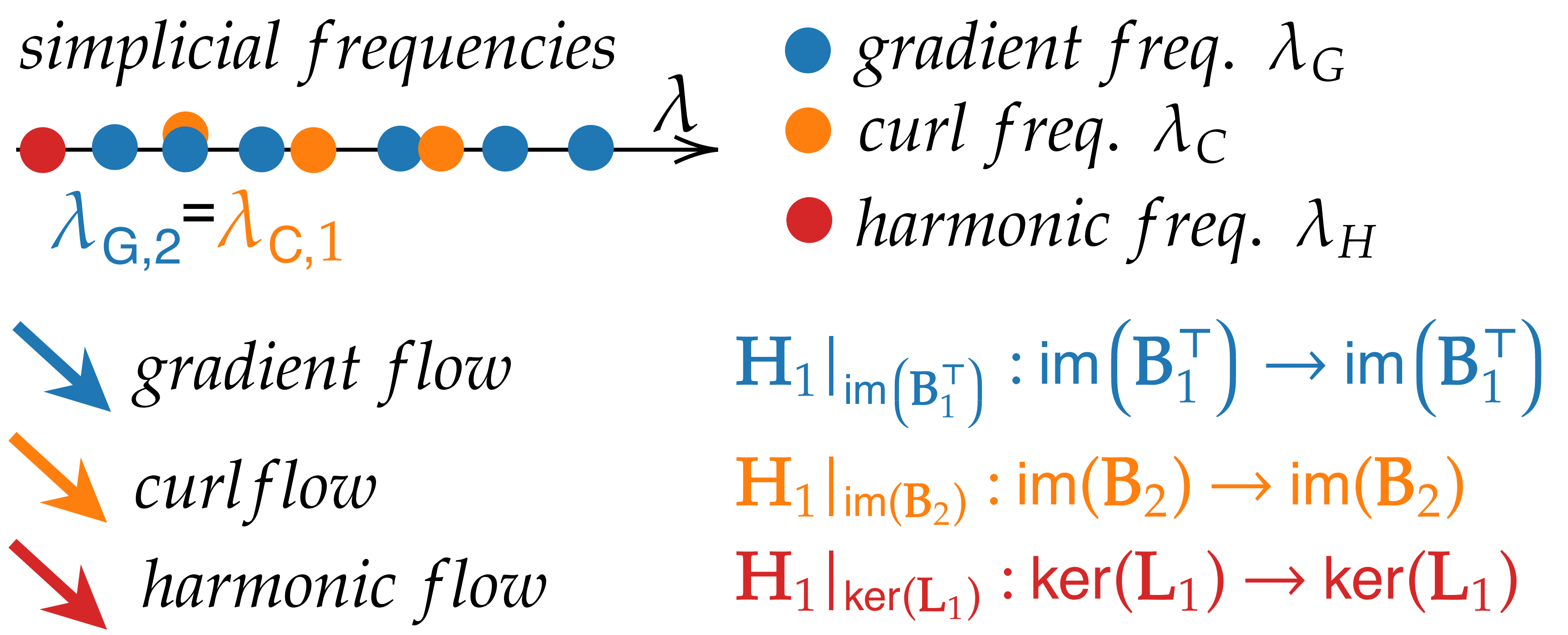
Pointwise Multiplication at frequencies

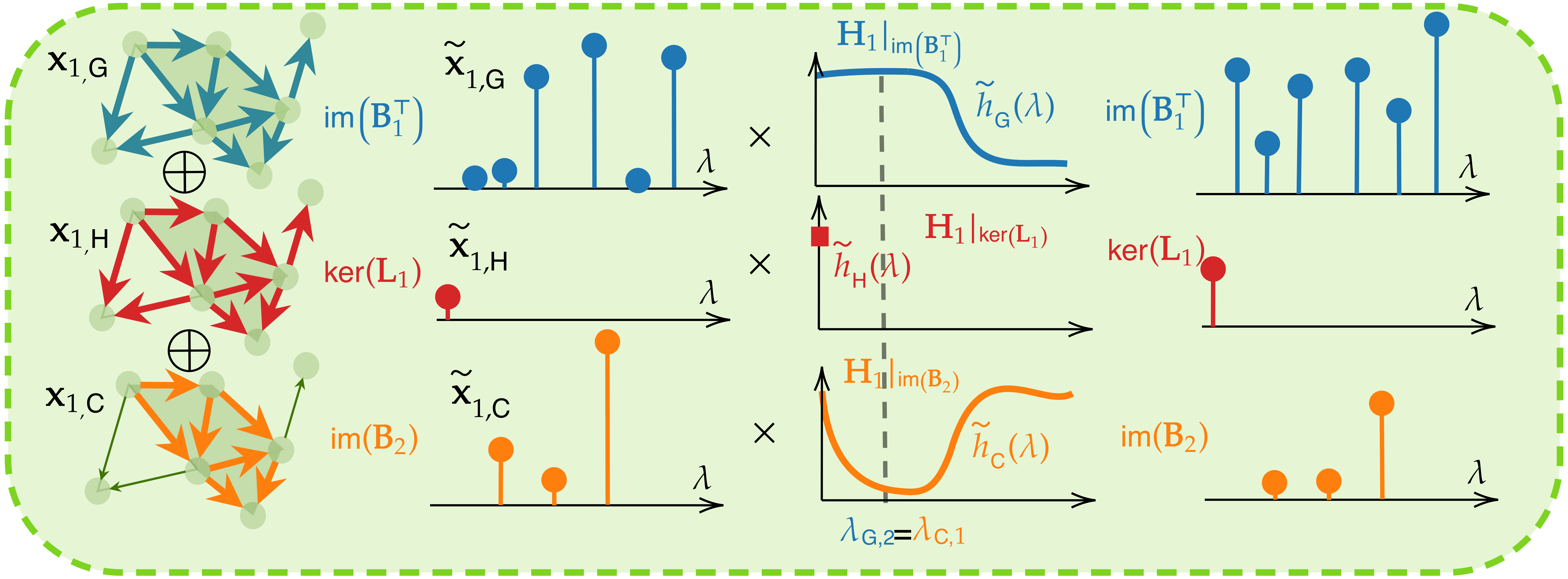
Spectral

$$\begin{cases} \tilde{H}_{\mathrm{H}}(\lambda) = \alpha_0 + \beta_0, & \text{for } \lambda \in \mathcal{Q}_{\mathrm{H}}, \\ \tilde{H}_{\mathrm{G}}(\lambda) = \sum_{k=0}^{K_d} \alpha_k \lambda^k, & \text{for } \lambda \in \mathcal{Q}_{\mathrm{G}}, \\ \tilde{H}_{\mathrm{C}}(\lambda) = \sum_{k=0}^{K_u} \beta_k \lambda^k, & \text{for } \lambda \in \mathcal{Q}_{\mathrm{C}} \end{cases}$$









Why two sets of coefficients instead of one set?

Filter Design

- Data-driven: given a training set $\mathcal{T}$ of input-output pairs

$$\min_{\boldsymbol{\alpha},\boldsymbol{\beta}} \frac{1}{|\mathcal{T}|} \sum \|\mathbf{Hf} - \mathbf{y}\|_2^2 + \gamma r(\boldsymbol{\alpha}, \boldsymbol{\beta})$$

- Spectral filter design
  - Least-Squares
  - Chebyshev polynomials

$$\begin{cases} \tilde{H}_{\mathrm{H}}(\lambda) = \alpha_0 + \beta_0 \approx g_0, & \text{for } \lambda \in \mathcal{Q}_{\mathrm{H}}, \\ \tilde{H}_{\mathrm{G}}(\lambda) = \sum_{k=0}^{K_d} \alpha_k \lambda^k \approx g_{\mathrm{G}}(\lambda), & \text{for } \lambda \in \mathcal{Q}_{\mathrm{G}}, \\ \tilde{H}_{\mathrm{C}}(\lambda) = \sum_{k=0}^{K_u} \beta_k \lambda^k \approx g_{\mathrm{C}}(\lambda), & \text{for } \lambda \in \mathcal{Q}_{\mathrm{C}} \end{cases}$$