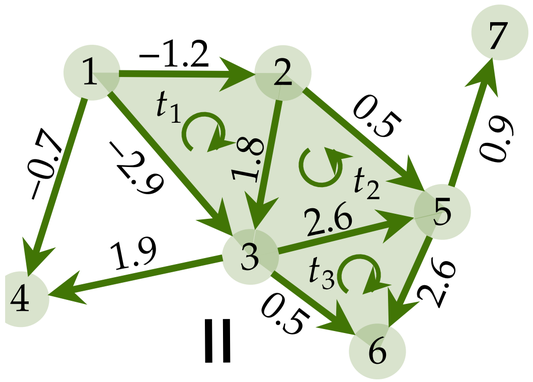
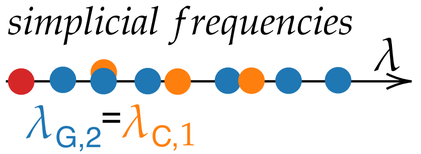
Edge Convolutions on SCs

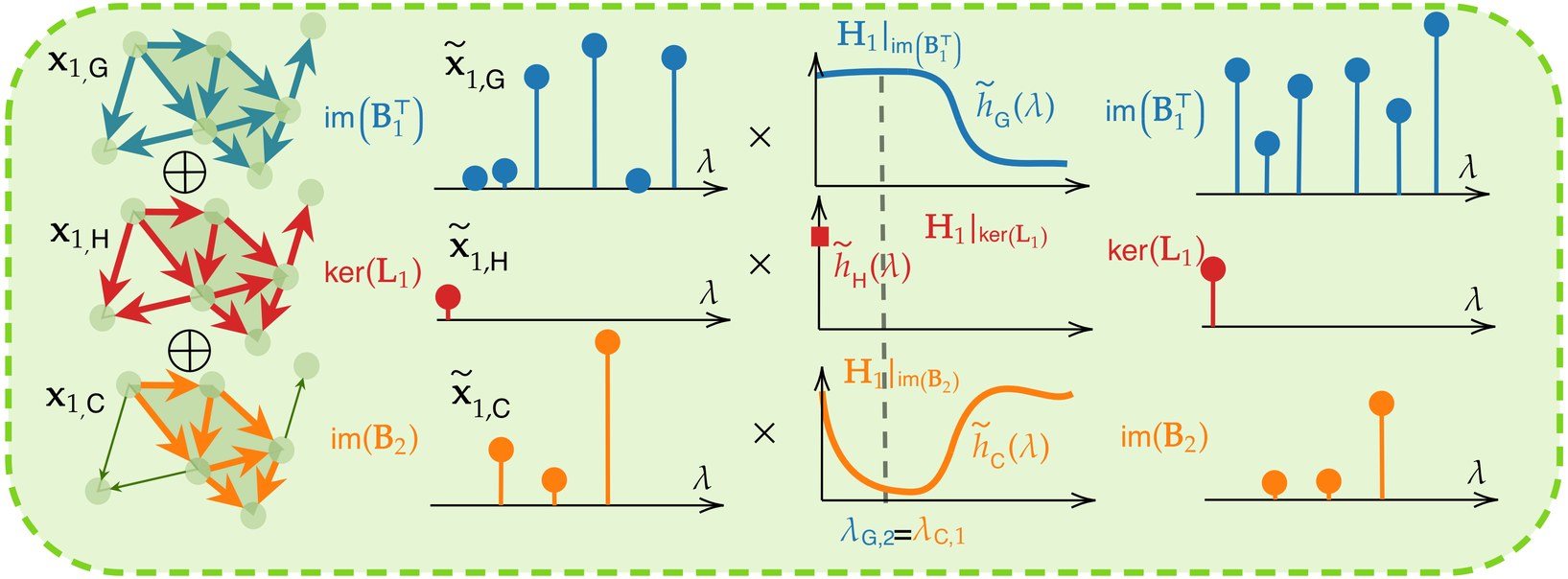
Pointwise Multiplication at frequencies



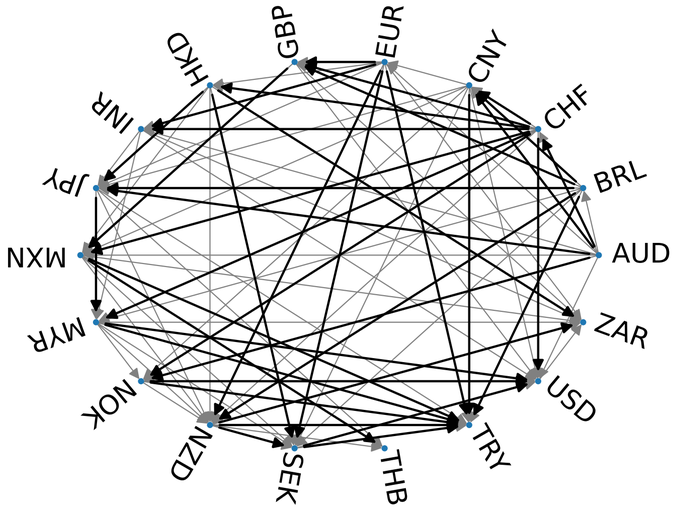


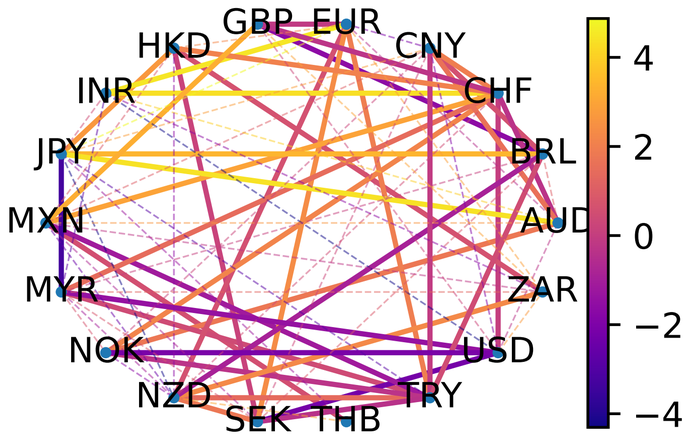
- *gradient freq.* λ_G
- *curl freq.* λ_C
- *harmonic freq.* λ_H

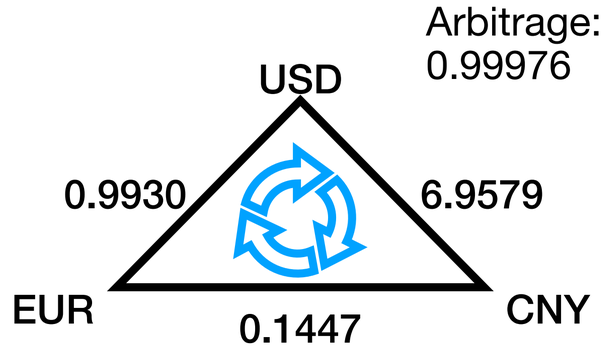
- *gradient flow* $\quad \mathbf{H}_1|_{\mathrm{im}(\mathbf{B}_1^\top)} : \mathrm{im}(\mathbf{B}_1^\top) \to \mathrm{im}(\mathbf{B}_1^\top)$
- *curl flow* $\quad \mathbf{H}_1|_{\mathrm{im}(\mathbf{B}_2)} : \mathrm{im}(\mathbf{B}_2) \to \mathrm{im}(\mathbf{B}_2)$
- *harmonic flow* $\quad \mathbf{H}_1|_{\ker(\mathbf{L}_1)} : \ker(\mathbf{L}_1) \to \ker(\mathbf{L}_1)$



Filtering for Forex







$$r^{a/b} r^{b/c} = r^{a/c}$$ Arbitrage-free

$$f = \log r$$

$$f_{[a,b]} + f_{[b,c]} - f_{[a,c]} = 0$$ Curl-free

Currency exchange rates captured from Yahoo!Finance, not arbitrage-free.

	USD	EUR	CNY	HKD	GBP	JPY	AUD
1 USD	1	0.8422	6.3739	7.7666	0.7207	110.1020	1.3377
1 EUR	1.1873	1	7.5681	9.2218	0.8557	130.7314	1.5883
1 CNY	0.1539	0.1321	1	1.2185	0.1131	17.2683	0.2099
1 HKD	0.1288	0.1085	0.8207	1	0.0928	14.1718	0.1723
1 GBP	1.3871	1.1685	8.8414	10.7732	1	152.6758	1.8557
1 JPY	0.0091	0.0077	0.0579	0.0706	0.0066	1	0.0122
1 AUD	0.7475	0.6299	4.7602	5.8001	0.5385	82.1837	1

Curl-free edge filters

For fully-connected graphs:

$$\mathbf{H}_{\text{curl-free}} = \frac{1}{N_0}\mathbf{L}_{\text{d}}$$

For general: need to perform design