

SIGMOD PODS 2026



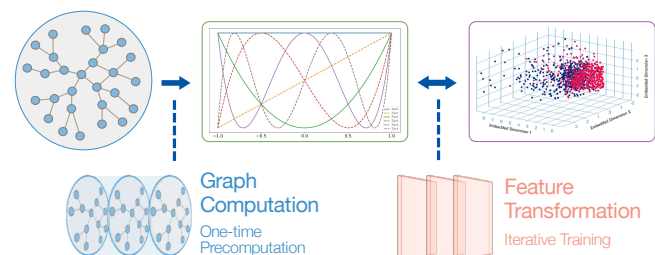
TAXONOMY

Iterative Model:

(Spatial) Graph

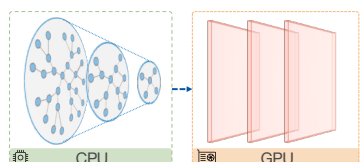
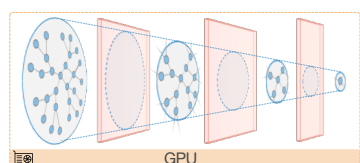
Spectral Features

Learned Features



Decoupled Model:

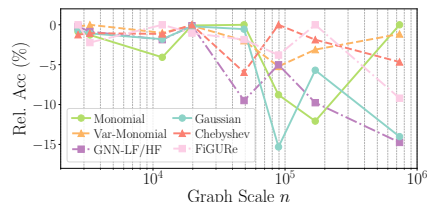
Coupled Model: $H^{(0)} = \tilde{A} \dots \tilde{A} X$ $H^{(l+1)} = \sigma(H^{(l)} W^{(l)})$



Type	Filter*	Filter Function $g(\mathbf{L})$	Param.	HP	Time	Memory	Model†
Fixed	Identity	$\mathbf{I}$	/	/	$O(KnF)$	$O(nF)$	MLP
	Linear	$2\mathbf{I} - \mathbf{\bar{L}}$	/	/	$O(KmF)$	$O(nF)$	1: GCN [46]
	Impulse	$(1 - \mathbf{\bar{L}})^K$	/	/	$O(KmF)$	$O(nF)$	D: SGC [102], gNN [81], GZoom [19], GRAND+ [26]
	Monomial	$\frac{1}{K!} \sum_{k=0}^K (1 - \mathbf{\bar{L}})^k$	/	/	$O(KmF)$	$O(nF)$	D: S ² GC [260], AGP [95], GRAND+ [26]
	PPR	$\sum_{k=0}^K (1 - \alpha)^k (1 - \mathbf{\bar{L}})^k$	/	α	$O(KmF)$	$O(nF)$	1: GLP [53], GCN [80], D: AFNN [47], GDC [32], AGP [95], GRAND+ [26]
	HK	$\sum_{k=0}^K \frac{e^{-\alpha k}}{k!} (1 - \mathbf{\bar{L}})^k$	/	α	$O(KmF)$	$O(nF)$	D: GDC [32], AGP [95], DGC [99]
Variable	Gaussian	$\sum_{k=0}^K \frac{e^{-\alpha k}}{k!} (2\mathbf{I} - \mathbf{\bar{L}})^k$	/	α	$O(KmF)$	$O(nF)$	D: G ² CN [51]
	Linear	$(1 + \theta)\mathbf{I} - \mathbf{\bar{L}}$	θ_k	/	$O(KmF)$	$O(nF)$	1: GIN [104], AKEGNN [45]
	Monomial	$\sum_{k=0}^K \theta_k (1 - \mathbf{\bar{L}})^k$	θ_k	/	$O(KmF)$	$O(nF)$	D: DAGNN [67], GPRGNN [17]
	Hornet	$\sum_{k=0}^K \theta_k (1 - \mathbf{\bar{L}})^k$	θ_k	/	$O(KmF)$	$O(2nF)$	1: ABMAGNN [6], HornetGCN [35]
	Chebyshev	$\sum_{k=0}^K \theta_k T_k^{\text{Cheb}}(\mathbf{\bar{L}})$	θ_k	/	$O(KmF)$	$O(2nF)$	1: EMBAGNN [4], ChebBase [40]
	ChebInterp	$\frac{1}{K!} \sum_{k=0}^K \sum_{l=0}^K \theta_{k,l} T_k^{\text{Cheb}}(\mathbf{\bar{L}}) T_l^{\text{Cheb}}(x_{\text{in}}) T_l^{\text{Cheb}}(\mathbf{\bar{L}})$	$\theta_{k,l}$	/	$O(KmF + K^2nF)$	$O(2nF)$	D: ChebNetII [40]
	Cleinschw	$\sum_{k=0}^K \theta_k T_k^{\text{Cheb}}(\mathbf{\bar{L}})$	θ_k	/	$O(KmF)$	$O(3nF)$	1: CleinschwGCN [39]
	Bernstein	$\sum_{k=0}^K \binom{K}{k} (\frac{1}{2})^k (2\mathbf{I} - \mathbf{\bar{L}})^{K-k} \mathbf{L}^k$	θ_k	α, β	$O(K^2mF)$	$O(nF)$	D: Bernstein [35]
	Legendre	$\sum_{k=0}^K \theta_k \frac{1}{k!} \binom{K}{k} (2\mathbf{I} - \mathbf{\bar{L}})^k \mathbf{L}^k$	θ_k	/	$O(KmF)$	$O(2nF)$	D: LegendreNet [12]
	Jacobi	$\sum_{k=0}^K \theta_k T_k^{\text{Jacobi}}(\mathbf{\bar{L}})$	θ_k	α, β	$O(KmF)$	$O(2nF)$	D: JacobiConv [98]
Bank	Favard	$\sum_{k=0}^K \theta_k T_k^{\text{Favard}}(\mathbf{\bar{L}})$	θ_k	/	$O(KmF + KnF)$	$O(2nF)$	D: FavardNet [36]
	OptBasis	$\sum_{k=0}^K \theta_k T_k^{\text{OptBasis}}(\mathbf{\bar{L}})$	θ_k	/	$O(KmF + KnF^2)$	$O(2nF)$	D: OptBasisGNN [36]
	Linear (channel-wise)	$ \mathcal{Q} ^2 (1 - \mathbf{Y}_q \mathbf{\bar{L}})$	$\mathbf{Y}_q$	/	$O(KmF)$	$O(nF)$	D: AdaGNN [21]
	Linear (LP, HP)	$\mathbf{y}_1 (1 - \mathbf{\bar{L}}) + \mathbf{y}_2 \mathbf{\bar{L}}$	$\mathbf{Y}_q$	/	$O(QKmF + QKnF)$	$O(QnF)$	1: FBGCN (LP) [72]
	Linear (LP, HP, ID)	$\mathbf{y}_1 (1 - \mathbf{\bar{L}}) + \mathbf{y}_2 \mathbf{\bar{L}} + \mathbf{y}_3 \mathbf{I}$	$\mathbf{Y}_q$	/	$O(QKmF + QKnF)$	$O(QnF)$	1: ACAMGNN (LP) [71]
	Linear (LP, HP)	$\mathbf{y}_1 ((\beta + 1)\mathbf{I} - \mathbf{\bar{L}}) + \mathbf{y}_2 ((\beta - 1)\mathbf{I} + \mathbf{\bar{L}})$	$\mathbf{Y}_q$	β	$O(QKmF)$	$O(QnF)$	D: FAGNN [8]
	Gaussian (LP, HP)	$\sum_{q=0}^Q \sum_{k=0}^K \frac{1}{k!} \binom{K}{k} ((1 + \beta) \mathbf{I} - \mathbf{\bar{L}})^k$	$\mathbf{Y}_q$	α_q, β_q	$O(QKmF)$	$O(QnF)$	D: G ² CN [51]
Mono, Cheb	PPR (LP, HP)	$\sum_{q=1}^Q \sum_{k=0}^K \alpha_q (1 - \alpha_q)^k (1 + \beta_q) (\mathbf{I} - \mathbf{\bar{L}})^k$	$\mathbf{Y}_q$	α_q, β_q	$O(QKmF)$	$O(QnF)$	D: GNN-LF [117]
		$\sum_{q=0}^Q \sum_{k=0}^K \alpha_q \mathbf{Y}_q \theta_k T_k^{\text{Cheb}}(\mathbf{\bar{L}})$	$\mathbf{Y}_q, \theta_k$	/	$O(QKmF)$	$O(QnF)$	D: FIGURE [24]

* **Filter:** LP = Low-pass, HP = High-pass, ID = Identity. * **Model:** I = Iterative architecture, D = Decoupled architecture.

- Larger graph
- Global view
- Varied accuracy

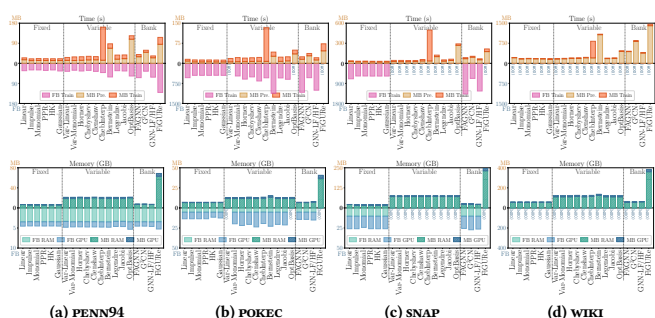


Effectiveness $\rightarrow$ Dominated by spectral property

Type		TSR	TSR ₀	TSR ₁	TSR ₂	TSR ₃	TSR ₄	TSR ₅	TSR ₆	TSR ₇	TSR ₈	TSR ₉	TSR ₁₀	TSR ₁₁	TSR ₁₂	TSR ₁₃	TSR ₁₄	TSR ₁₅	TSR ₁₆	TSR ₁₇	TSR ₁₈	TSR ₁₉	TSR ₂₀	TSR ₂₁	TSR ₂₂	TSR ₂₃	TSR ₂₄	TSR ₂₅	TSR ₂₆	TSR ₂₇	TSR ₂₈	TSR ₂₉	TSR ₃₀	TSR ₃₁	TSR ₃₂	TSR ₃₃	TSR ₃₄	TSR ₃₅	TSR ₃₆	TSR ₃₇	TSR ₃₈	TSR ₃₉	TSR ₄₀	TSR ₄₁	TSR ₄₂	TSR ₄₃	TSR ₄₄	TSR ₄₅	TSR ₄₆	TSR ₄₇	TSR ₄₈	TSR ₄₉	TSR ₅₀	TSR ₅₁	TSR ₅₂	TSR ₅₃	TSR ₅₄	TSR ₅₅	TSR ₅₆	TSR ₅₇	TSR ₅₈	TSR ₅₉	TSR ₆₀	TSR ₆₁	TSR ₆₂	TSR ₆₃	TSR ₆₄	TSR ₆₅	TSR ₆₆	TSR ₆₇	TSR ₆₈	TSR ₆₉	TSR ₇₀	TSR ₇₁	TSR ₇₂	TSR ₇₃	TSR ₇₄	TSR ₇₅	TSR ₇₆	TSR ₇₇	TSR ₇₈	TSR ₇₉	TSR ₈₀	TSR ₈₁	TSR ₈₂	TSR ₈₃	TSR ₈₄	TSR ₈₅	TSR ₈₆	TSR ₈₇	TSR ₈₈	TSR ₈₉	TSR ₉₀	TSR ₉₁	TSR ₉₂	TSR ₉₃	TSR ₉₄	TSR ₉₅	TSR ₉₆	TSR ₉₇	TSR ₉₈	TSR ₉₉	TSR ₁₀₀	TSR ₁₀₁	TSR ₁₀₂	TSR ₁₀₃	TSR ₁₀₄	TSR ₁₀₅	TSR ₁₀₆	TSR ₁₀₇	TSR ₁₀₈	TSR ₁₀₉	TSR ₁₁₀	TSR ₁₁₁	TSR ₁₁₂	TSR ₁₁₃	TSR ₁₁₄	TSR ₁₁₅	TSR ₁₁₆	TSR ₁₁₇	TSR ₁₁₈	TSR ₁₁₉	TSR ₁₂₀	TSR ₁₂₁	TSR ₁₂₂	TSR ₁₂₃	TSR ₁₂₄	TSR ₁₂₅	TSR ₁₂₆	TSR ₁₂₇	TSR ₁₂₈	TSR ₁₂₉	TSR ₁₃₀	TSR ₁₃₁	TSR ₁₃₂	TSR ₁₃₃	TSR ₁₃₄	TSR ₁₃₅	TSR ₁₃₆	TSR ₁₃₇	TSR ₁₃₈	TSR ₁₃₉	TSR ₁₄₀	TSR ₁₄₁	TSR ₁₄₂	TSR ₁₄₃	TSR ₁₄₄	TSR ₁₄₅	TSR ₁₄₆	TSR ₁₄₇	TSR ₁₄₈	TSR ₁₄₉	TSR ₁₅₀	TSR ₁₅₁	TSR ₁₅₂	TSR ₁₅₃	TSR ₁₅₄	TSR ₁₅₅	TSR ₁₅₆	TSR ₁₅₇	TSR ₁₅₈	TSR ₁₅₉	TSR ₁₆₀	TSR ₁₆₁	TSR ₁₆₂	TSR ₁₆₃	TSR ₁₆₄	TSR ₁₆₅	TSR ₁₆₆	TSR ₁₆₇	TSR ₁₆₈	TSR ₁₆₉	TSR ₁₇₀	TSR ₁₇₁	TSR ₁₇₂	TSR ₁₇₃	TSR ₁₇₄	TSR ₁₇₅	TSR ₁₇₆	TSR ₁₇₇	TSR ₁₇₈	TSR ₁₇₉	TSR ₁₈₀	TSR ₁₈₁	TSR ₁₈₂	TSR ₁₈₃	TSR ₁₈₄	TSR ₁₈₅	TSR ₁₈₆	TSR ₁₈₇	TSR ₁₈₈	TSR ₁₈₉	TSR ₁₉₀	TSR ₁₉₁	TSR ₁₉₂	TSR ₁₉₃	TSR ₁₉₄	TSR ₁₉₅	TSR ₁₉₆	TSR ₁₉₇	TSR ₁₉₈	TSR ₁₉₉	TSR ₂₀₀	TSR ₂₀₁	TSR ₂₀₂	TSR ₂₀₃	TSR ₂₀₄	TSR ₂₀₅	TSR ₂₀₆	TSR ₂₀₇	TSR ₂₀₈	TSR ₂₀₉	TSR ₂₁₀	TSR ₂₁₁	TSR ₂₁₂	TSR ₂₁₃	TSR ₂₁₄	TSR ₂₁₅	TSR ₂₁₆	TSR ₂₁₇	TSR ₂₁₈	TSR ₂₁₉	TSR ₂₂₀	TSR ₂₂₁	TSR ₂₂₂	TSR ₂₂₃	TSR ₂₂₄	TSR ₂₂₅	TSR ₂₂₆	TSR ₂₂₇	TSR ₂₂₈	TSR ₂₂₉	TSR ₂₃₀	TSR ₂₃₁	TSR ₂₃₂	TSR ₂₃₃	TSR ₂₃₄	TSR ₂₃₅	TSR ₂₃₆	TSR ₂₃₇	TSR ₂₃₈	TSR ₂₃₉	TSR ₂₄₀	TSR ₂₄₁	TSR ₂₄₂	TSR ₂₄₃	TSR ₂₄₄	TSR ₂₄₅	TSR ₂₄₆	TSR ₂₄₇	TSR ₂₄₈	TSR ₂₄₉	TSR ₂₅₀	TSR ₂₅₁	TSR ₂₅₂	TSR ₂₅₃	TSR ₂₅₄	TSR ₂₅₅	TSR ₂₅₆	TSR ₂₅₇	TSR ₂₅₈	TSR ₂₅₉	TSR ₂₆₀	TSR ₂₆₁	TSR ₂₆₂	TSR ₂₆₃	TSR ₂₆₄	TSR ₂₆₅	TSR ₂₆₆	TSR ₂₆₇	TSR ₂₆₈	TSR ₂₆₉	TSR ₂₇₀	TSR ₂₇₁	TSR ₂₇₂	TSR ₂₇₃	TSR ₂₇₄	TSR ₂₇₅	TSR ₂₇₆	TSR ₂₇₇	TSR ₂
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INSIGHTS

Time: Feature Transformation $\rightarrow$ Graph operation
Memory: Network Parameters $\rightarrow$ Graph features



- **Scalability bottleneck** → faster graph operations
 - Small scale: network-dominant
 - Large scale: graph-dominant
- **Effectiveness** → understand graph pattern
 - Suitable filter: graph-specific improvement
 - Variable params: benefit generality
- **Effectiveness vs Efficiency** → not mutually exclusive
 - Simple filters: can excel in common tasks
 - Complicated designs: need to consider overhead

[Paper]

doi/10.1145/3749156

[Code]

github.com/gdmnl/
Spectral-GNN-Benchmark

[Presenter]

nyliao.
github.io