High-Performance Graphics 2025
A. Knoll and C. Peters
(Guest Editors)

COMPUTER GRAPHICS *forum*
Volume 44 (*2025*), *Number 8*

Fused Collapsing for Wide BVH Construction Supplemental material

Wilhem Barbier and Mathias Paulin

IRIT, Université de Toulouse, CNRS

See next page for the additional tables.

	Algorithm	**Hierarchy** (ms)	**Build** (ms)	**SAH**	**Trace** (ms)	**Avg traversed** #nodes	**Combined time** (ms)
			Bistro Exterior (2.8M triangles)				
BVH4	H-PLOC+TopDown	4.6 (×1)	6.6 (×1)	70.3 (×1)	31.5 (×1)	53.2 (×1)	38.1 (×1)
BVH4	LBVH+TopDown	3.3 (×0.73)	5.3 (×0.80)	80.5 (×1.14)	41.3 (×1.31)	64.6 (×1.21)	46.6 (×1.22)
BVH4	Ours	2.6 (×0.58)	4.3(×0.66)	68.9 (×0.98)	43.7 (×1.39)	57.1 (×1.07)	48.0 (×1.26)
BVH8	H-PLOC+TopDown	4.7 (×1)	6.7 (×1)	57.9 (×1)	31.0 (×1)	35.1 (×1)	37.6 (×1)
BVH8	LBVH+TopDown	3.9 (×0.83)	5.8 (×0.87)	63.5 (×1.10)	35.2 (×1.14)	41.9 (×1.19)	41.0 (×1.09)
BVH8	Ours	2.7 (×0.57)	4.4(×0.66)	56.9 (×0.98)	37.6 (×1.22)	38.0 (×1.08)	42.0 (×1.12)
			Hairball (2.9M triangles)				
BVH4	H-PLOC+TopDown	3.9 (×1)	6.0 (×1)	350.3 (×1)	18.7 (×1)	48.5 (×1)	24.7 (×1)
BVH4	LBVH+TopDown	3.4 (×0.87)	5.4 (×0.91)	363.7 (×1.04)	16.7 (×0.89)	49.2 (×1.01)	22.2 (×0.90)
BVH4	Ours	2.3 (×0.59)	4.2(×0.70)	346.1 (×0.99)	15.7 (×0.84)	53.0 (×1.09)	19.8 (×0.80)
BVH8	H-PLOC+TopDown	4.3 (×1)	6.3 (×1)	295.0 (×1)	17.7 (×1)	34.7 (×1)	24.0 (×1)
BVH8	LBVH+TopDown	3.7 (×0.86)	5.7 (×0.90)	295.6 (×1.00)	16.5 (×0.93)	34.1 (×0.98)	22.2 (×0.92)
BVH8	Ours	2.4 (×0.55)	4.1(×0.66)	284.3 (×0.96)	16.2 (×0.91)	37.8 (×1.09)	20.3 (×0.85)
			Rungholt (5.8M triangles)				
BVH4	H-PLOC+TopDown	7.6 (×1)	11.8 (×1)	64.9 (×1)	8.6 (×1)	21.9 (×1)	20.4 (×1)
BVH4	LBVH+TopDown	7.1 (×0.94)	11.4 (×0.97)	78.0 (×1.20)	8.5 (×0.99)	22.9 (×1.05)	19.9 (×0.98)
BVH4	Ours	4.2 (×0.56)	8.1(×0.68)	72.4 (×1.12)	10.3 (×1.20)	26.5 (×1.21)	18.3 (×0.90)
BVH8	H-PLOC+TopDown	8.0 (×1)	12.0 (×1)	47.1 (×1)	8.8 (×1)	15.4 (×1)	20.9 (×1)
BVH8	LBVH+TopDown	7.6 (×0.96)	11.7 (×0.97)	54.9 (×1.16)	8.8 (×1.00)	16.1 (×1.04)	20.5 (×0.98)
BVH8	Ours	4.4 (×0.55)	8.3(×0.69)	56.2 (×1.19)	11.1 (×1.26)	20.5 (×1.33)	19.4 (×0.93)
			San Miguel (10M triangles)				
BVH4	H-PLOC+TopDown	15.7 (×1)	22.2 (×1)	40.8 (×1)	20.5 (×1)	43.4 (×1)	42.7 (×1)
BVH4	LBVH+TopDown	12.4 (×0.79)	18.9 (×0.85)	53.9 (×1.32)	27.7 (×1.35)	63.0 (×1.45)	46.6 (×1.09)
BVH4	Ours	8.1 (×0.51)	13.9(×0.63)	42.9 (×1.05)	25.7 (×1.25)	48.9 (×1.13)	39.6 (×0.93)
BVH8	H-PLOC+TopDown	16.4 (×1)	22.6 (×1)	31.1 (×1)	21.1 (×1)	30.0 (×1)	43.8 (×1)
BVH8	LBVH+TopDown	14.6 (×0.89)	20.8 (×0.92)	38.8 (×1.25)	27.6 (×1.30)	41.9 (×1.40)	48.4 (×1.11)
BVH8	Ours	9.2 (×0.56)	15.9(×0.70)	34.1 (×1.10)	27.4 (×1.29)	38.1 (×1.27)	43.3 (×0.99)
			Powerplant (12.8M triangles)				
BVH4	H-PLOC+TopDown	19.5 (×1)	28.9 (×1)	25.8 (×1)	58.1 (×1)	54.7 (×1)	86.9 (×1)
BVH4	LBVH+TopDown	16.6 (×0.85)	25.1 (×0.87)	31.2 (×1.21)	66.9 (×1.15)	79.1 (×1.45)	92.1 (×1.06)
BVH4	Ours	10.0 (×0.51)	17.6(×0.61)	25.3 (×0.98)	54.1 (×0.93)	58.1 (×1.06)	71.7 (×0.82)
BVH8	H-PLOC+TopDown	19.1 (×1)	27.1 (×1)	20.9 (×1)	55.5 (×1)	38.3 (×1)	82.6 (×1)
BVH8	LBVH+TopDown	17.7 (×0.93)	25.5 (×0.94)	23.9 (×1.15)	60.1 (×1.08)	51.6 (×1.35)	85.6 (×1.04)
BVH8	Ours	9.1 (×0.48)	16.4(×0.61)	20.9 (×1.00)	57.7 (×1.04)	44.3 (×1.16)	74.1 (×0.90)
			Moore Lane House (15.2M triangles)				
BVH4	H-PLOC+TopDown	22.9 (×1)	34.3 (×1)	16.2 (×1)	15.0 (×1)	32.9 (×1)	49.4 (×1)
BVH4	LBVH+TopDown	20.2 (×0.88)	30.9 (×0.90)	18.6 (×1.14)	17.5 (×1.16)	40.6 (×1.23)	48.4 (×0.98)
BVH4	Ours	14.0 (×0.61)	23.2(×0.68)	17.7 (×1.09)	17.3 (×1.15)	37.0 (×1.13)	40.5 (×0.82)
BVH8	H-PLOC+TopDown	24.8 (×1)	34.9 (×1)	11.9 (×1)	15.7 (×1)	22.6 (×1)	50.6 (×1)
BVH8	LBVH+TopDown	22.1 (×0.89)	32.9 (×0.94)	13.2 (×1.11)	17.8 (×1.13)	27.1 (×1.20)	50.8 (×1.00)
BVH8	Ours	14.0 (×0.56)	23.1(×0.66)	13.9 (×1.17)	19.8 (×1.26)	28.5 (×1.26)	42.9 (×0.85)

Table 1: *Results on static scenes with 4 diffuse secondary rays per pixel.*

	Algorithm	**Hierarchy** (ms)	**Build** (ms)	**SAH**	**Trace** (ms)	**Avg traversed** #nodes	**Combined time** (ms)
			Bistro Exterior (2.8M triangles)				
BVH4	H-PLOC+TopDown	4.5 (×1)	6.5 (×1)	70.3 (×1)	63.3 (×1)	54.2 (×1)	69.8 (×1)
BVH4	LBVH+TopDown	3.5 (×0.79)	5.5 (×0.85)	80.5 (×1.14)	82.4 (×1.30)	65.4 (×1.21)	87.9 (×1.26)
BVH4	Ours	2.6 (×0.58)	4.4(×0.68)	68.9 (×0.98)	87.5 (×1.38)	58.2 (×1.07)	91.9 (×1.32)
BVH8	H-PLOC+TopDown	4.5 (×1)	6.4 (×1)	57.9 (×1)	61.8 (×1)	35.8 (×1)	68.2 (×1)
BVH8	LBVH+TopDown	3.6 (×0.81)	5.5 (×0.86)	63.5 (×1.10)	71.6 (×1.16)	42.8 (×1.20)	77.1 (×1.13)
BVH8	Ours	2.7 (×0.61)	4.4(×0.68)	56.9 (×0.98)	75.0 (×1.21)	39.1 (×1.09)	79.4 (×1.16)
			Hairball (2.9M triangles)				
BVH4	H-PLOC+TopDown	3.9 (×1)	5.9 (×1)	350.3 (×1)	34.9 (×1)	48.6 (×1)	40.8 (×1)
BVH4	LBVH+TopDown	3.4 (×0.88)	5.4 (×0.92)	363.7 (×1.04)	32.7 (×0.94)	49.2 (×1.01)	38.1 (×0.93)
BVH4	Ours	2.4 (×0.60)	4.2(×0.70)	346.1 (×0.99)	29.3 (×0.84)	53.1 (×1.09)	33.4 (×0.82)
BVH8	H-PLOC+TopDown	4.3 (×1)	6.3 (×1)	295.0 (×1)	35.0 (×1)	34.8 (×1)	41.3 (×1)
BVH8	LBVH+TopDown	3.8 (×0.89)	5.8 (×0.92)	295.6 (×1.00)	32.4 (×0.93)	34.2 (×0.98)	38.2 (×0.92)
BVH8	Ours	2.4 (×0.56)	4.2(×0.66)	284.3 (×0.96)	31.2 (×0.89)	37.8 (×1.09)	35.4 (×0.86)
			Rungholt (5.8M triangles)				
BVH4	H-PLOC+TopDown	7.7 (×1)	11.9 (×1)	64.9 (×1)	16.1 (×1)	22.1 (×1)	28.0 (×1)
BVH4	LBVH+TopDown	7.2 (×0.94)	11.5 (×0.97)	78.0 (×1.20)	16.2 (×1.01)	23.2 (×1.05)	27.8 (×0.99)
BVH4	Ours	4.2 (×0.55)	8.0(×0.68)	72.4 (×1.12)	19.2 (×1.20)	27.1 (×1.23)	27.3 (×0.98)
BVH8	H-PLOC+TopDown	7.5 (×1)	11.6 (×1)	47.1 (×1)	16.7 (×1)	15.5 (×1)	28.3 (×1)
BVH8	LBVH+TopDown	7.0 (×0.93)	11.0 (×0.95)	54.9 (×1.16)	17.0 (×1.02)	16.1 (×1.04)	28.0 (×0.99)
BVH8	Ours	4.4 (×0.58)	8.2(×0.71)	56.2 (×1.19)	21.6 (×1.30)	20.4 (×1.31)	29.8 (×1.06)
			San Miguel (10M triangles)				
BVH4	H-PLOC+TopDown	15.6 (×1)	21.9 (×1)	40.8 (×1)	40.8 (×1)	43.8 (×1)	62.7 (×1)
BVH4	LBVH+TopDown	13.2 (×0.85)	19.7 (×0.90)	53.9 (×1.32)	55.3 (×1.35)	64.1 (×1.46)	74.9 (×1.19)
BVH4	Ours	8.9 (×0.57)	15.6(×0.71)	42.9 (×1.05)	51.5 (×1.26)	49.7 (×1.13)	67.1 (×1.07)
BVH8	H-PLOC+TopDown	15.8 (×1)	22.0 (×1)	31.1 (×1)	42.1 (×1)	30.6 (×1)	64.1 (×1)
BVH8	LBVH+TopDown	13.2 (×0.84)	19.4 (×0.88)	38.8 (×1.25)	55.3 (×1.31)	41.9 (×1.37)	74.7 (×1.17)
BVH8	Ours	9.2 (×0.58)	16.1(×0.73)	34.1 (×1.10)	54.6 (×1.30)	37.9 (×1.24)	70.7 (×1.10)
			Powerplant (12.8M triangles)				
BVH4	H-PLOC+TopDown	19.1 (×1)	27.4 (×1)	25.8 (×1)	92.2 (×1)	54.9 (×1)	119.6 (×1)
BVH4	LBVH+TopDown	15.9 (×0.83)	24.3 (×0.89)	31.2 (×1.21)	109.5 (×1.19)	81.2 (×1.48)	133.8 (×1.12)
BVH4	Ours	10.0 (×0.52)	17.3(×0.63)	25.3 (×0.98)	89.1 (×0.97)	59.0 (×1.07)	106.5 (×0.89)
BVH8	H-PLOC+TopDown	19.0 (×1)	26.9 (×1)	20.9 (×1)	88.2 (×1)	39.8 (×1)	115.1 (×1)
BVH8	LBVH+TopDown	16.5 (×0.87)	24.3 (×0.90)	23.9 (×1.15)	98.5 (×1.12)	53.2 (×1.34)	122.7 (×1.07)
BVH8	Ours	9.2 (×0.48)	17.2(×0.64)	20.9 (×1.00)	99.1 (×1.12)	46.0 (×1.16)	116.2 (×1.01)
			Moore Lane House (15.2M triangles)				
BVH4	H-PLOC+TopDown	22.9 (×1)	34.2 (×1)	16.2 (×1)	29.9 (×1)	32.9 (×1)	64.1 (×1)
BVH4	LBVH+TopDown	19.5 (×0.85)	30.4 (×0.89)	18.6 (×1.14)	34.8 (×1.16)	40.9 (×1.24)	65.2 (×1.02)
BVH4	Ours	13.3 (×0.58)	22.7(×0.66)	17.7 (×1.09)	34.3 (×1.15)	37.5 (×1.14)	57.0 (×0.89)
BVH8	H-PLOC+TopDown	24.5 (×1)	36.1 (×1)	11.9 (×1)	31.2 (×1)	23.5 (×1)	67.2 (×1)
BVH8	LBVH+TopDown	22.5 (×0.92)	32.9 (×0.91)	13.2 (×1.11)	35.6 (×1.14)	28.1 (×1.19)	68.5 (×1.02)
BVH8	Ours	13.6 (×0.56)	22.7(×0.63)	13.9 (×1.17)	39.6 (×1.27)	28.7 (×1.22)	62.3 (×0.93)

Table 2: *Results on dynamic scenes with 8 diffuse secondary rays per pixel.*

Scene	**Width**	**HPLOC+TopDown**		**LBVH+TopDown**		**Ours**			
		HPLOC	TopDown	LBVH	TopDown	Fused collapsing	Compute indices	Write BVH	Reorder
Bistro Exterior	BVH4	1.9	2.9	1.4	2.8	1.9	0.1	0.5	0.1
	BVH8	1.7	2.9	0.9	2.9	2.0	0.1	0.4	0.1
Hairball	BVH4	1.4	2.8	0.9	2.8	1.6	0.1	0.5	0.1
	BVH8	1.4	3.1	0.9	2.9	1.7	0.1	0.5	0.1
Rungholt	BVH4	2.4	5.5	1.6	5.9	2.9	0.2	1.0	0.1
	BVH8	2.4	5.3	1.6	5.7	3.1	0.2	0.9	0.1
San Miguel	BVH4	6.1	11.2	3.0	10.6	6.8	0.4	1.5	0.1
	BVH8	6.1	10.9	3.0	11.0	6.5	0.3	1.3	0.1
Powerplant	BVH4	6.6	13.6	3.8	13.5	6.5	0.5	2.7	0.1
	BVH8	6.6	13.5	3.7	13.0	7.0	0.4	1.6	0.1
Moore Lane House	BVH4	7.8	16.4	4.6	16.1	9.9	0.6	2.5	0.1
	BVH8	7.8	15.5	4.6	16.0	10.8	0.5	2.4	0.1

Table 3: *Timings for the different stages of the compared build algorithms. All values are in milliseconds (ms).*