505,440 WCA MBLD Scrambles with 3-Style

Timo Forsthofer, Simon Hiesl

December 20, 2021

Abstract

We generated 505,440 WCA multiblind scramble with the official scrambling program (TNoodle) and analyzed them with a python program we wrote for that purpose. For that reason we **cannot** guarantee absolute flawlessness of our results. Our goal was to find as much information as possible about the scrambles with the assumption of using 3-Style with UF and UFR buffers. We evaluated the amount of flips, twists and the algorithm distributions with different advanced techniques like (full) floating, LTCT and premoves.

Contents

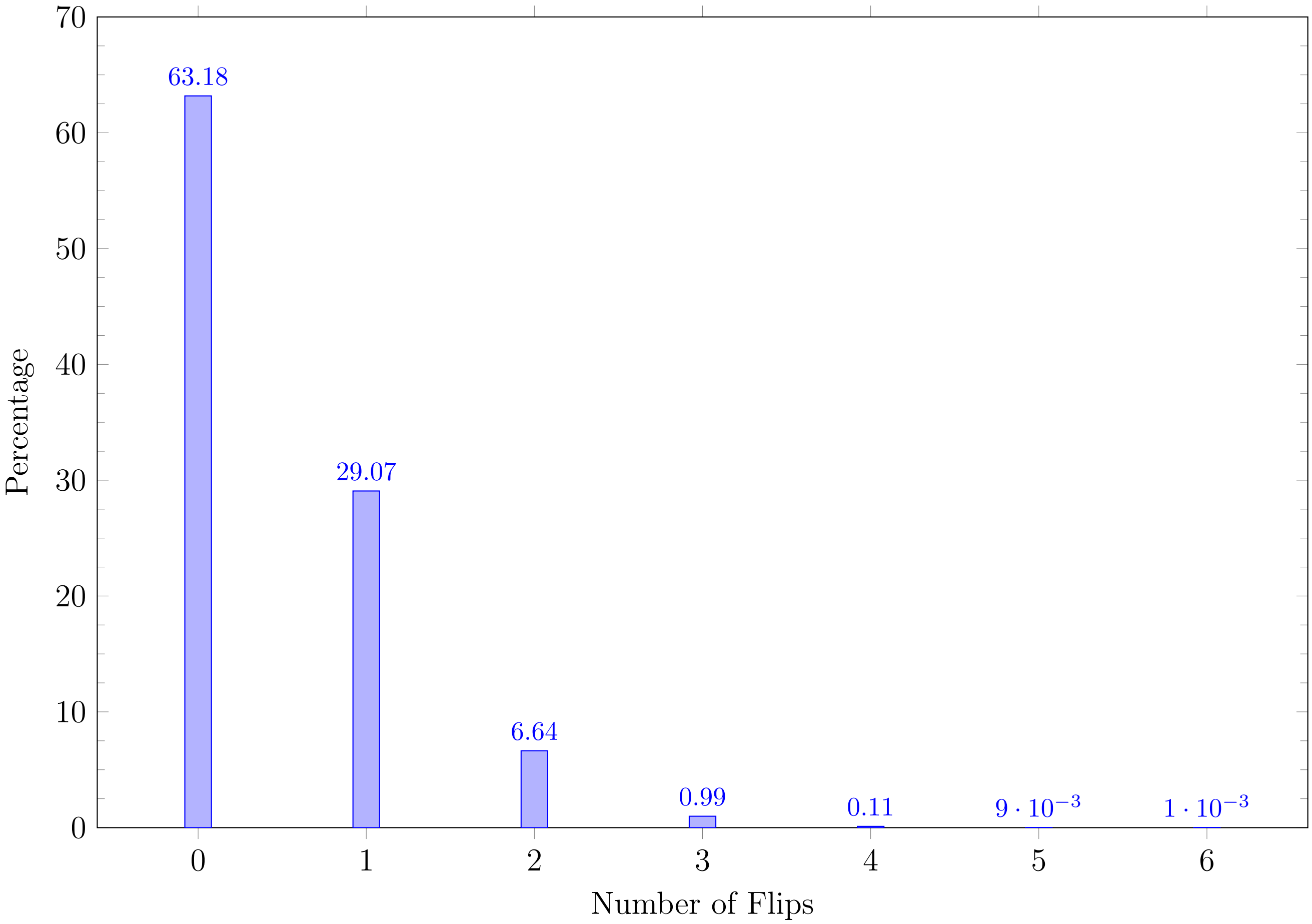
1 Edge Flips

The first thing we did was to find the amount of flips in our scrambles. We did not include our buffer UF.

Table 1: Edge Flips

	0	1	2	3	4	5	6
Percentage	63.2%	29.1%	6.6%	1.0%	0.11%	0.01%	0.001%
Amount	319,357	146,928	33,561	4,986	558	44	6

Figure 1: Edge Flips



On average there are **0.458** edge flips per scramble (excluding the buffer).

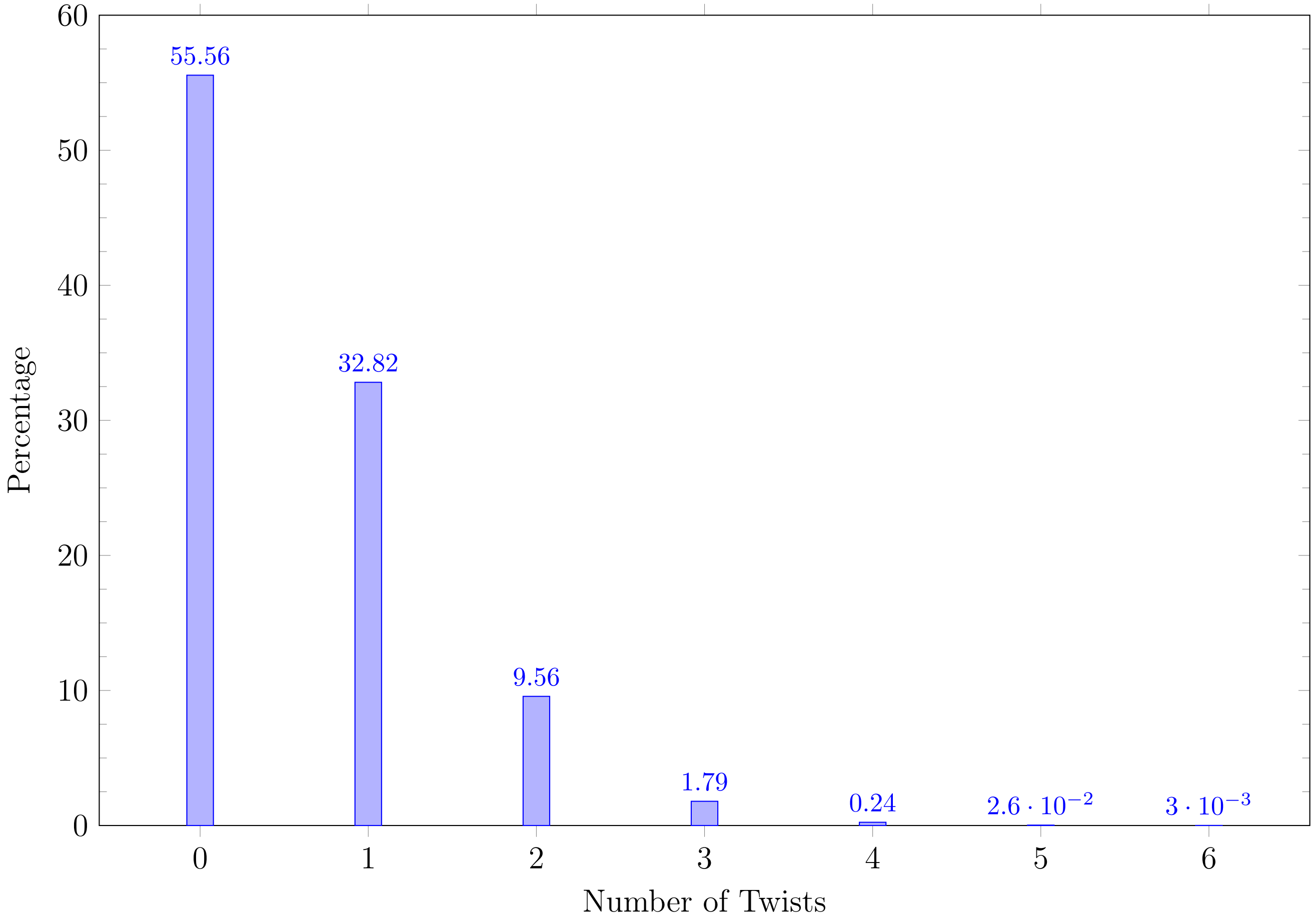
2 Corner Twists

A corner an be twisted in two directions. The tuple (X , Y) denotes how many corners are twisted in either direction, i. e. X corners are twisted clockwise and Y anti-clockwise or vice versa. Again we did not include the buffer UFR.

Table 2: Corner Twists

	(0 , 0)	(1 , 0)	(1 , 1)	(2 , 0)	(2 , 1)	(2 , 2)	(3 , 0)	(3 , 1)	(3 , 2)	(3 , 3)	(4 , 0)	(4 , 1)	(4 , 2)	(5 , 0)	(5 , 1)
Percentage	55.56%	32.82%	4.79%	4.78%	1.34%	0.09%	0.45%	0.12%	0.017%	0.0006%	0.03%	0.009%	0.002%	0.0008%	0.0002%
Amount	280,808	165,877	24,194	24,141	6,770	444	2,294	608	85	3	156	43	12	4	1

Figure 2: Corner Twists



On average there are **0.584** corner twists per scramble (excluding the buffer).

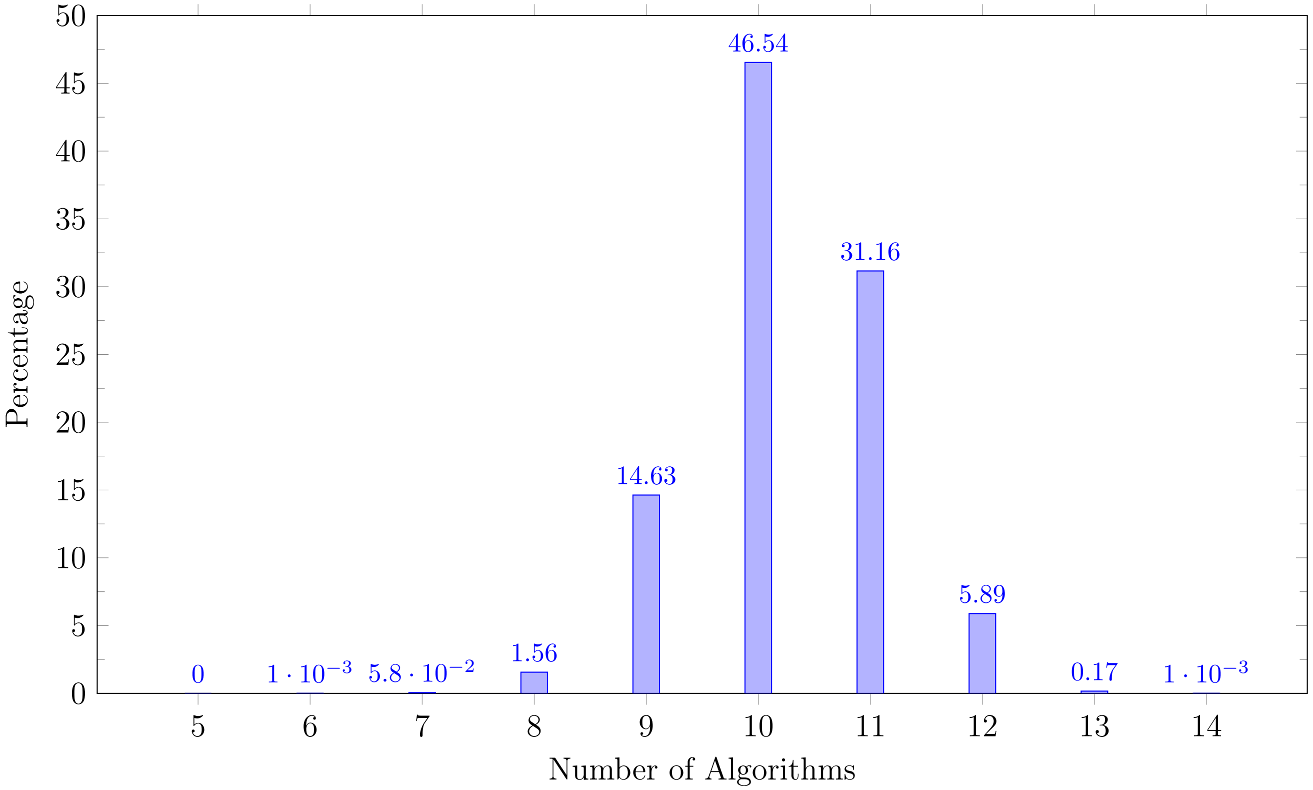
3 Number of Algorithms using Basic 3-Style

To determine the statistical distribution of the algorithm count, we made the following assumptions:
Basic 3-Style with UF and UFR buffers without floating, LTCT, etc. with white top and green front orientation. Two flips and four flips count as one algorithm each, so up to four flips can be solved with one algorithm, while five or six flips count as two. Two corners twisted in opposite directions are considered one algorithm, while three corners twisted in the same direction contribute two algorithms even if the buffer is not included. For parity we did a UR and UF pseudo swap.

Table 3: Number of Basic 3-Style Algorithms

	5	6	7	8	9	10	11	12	13	14
Percentage	0.0%	0.001%	0.058%	1.56%	14.63%	46.54%	31.16%	5.89%	0.17%	0.001%
Amount	0	3	294	7,900	73,937	235,215	157,489	29,758	837	7

Figure 3: Distribution of Basic 3-Style Algorithm Count



The average algorithm count is **10.26**. This distribution will from now on be our benchmark for comparison.

4 Number of Algorithms using Full Floating

We took every possible opportunity for floating including executing parity from UFR and afterwards doing a floating algorithm.

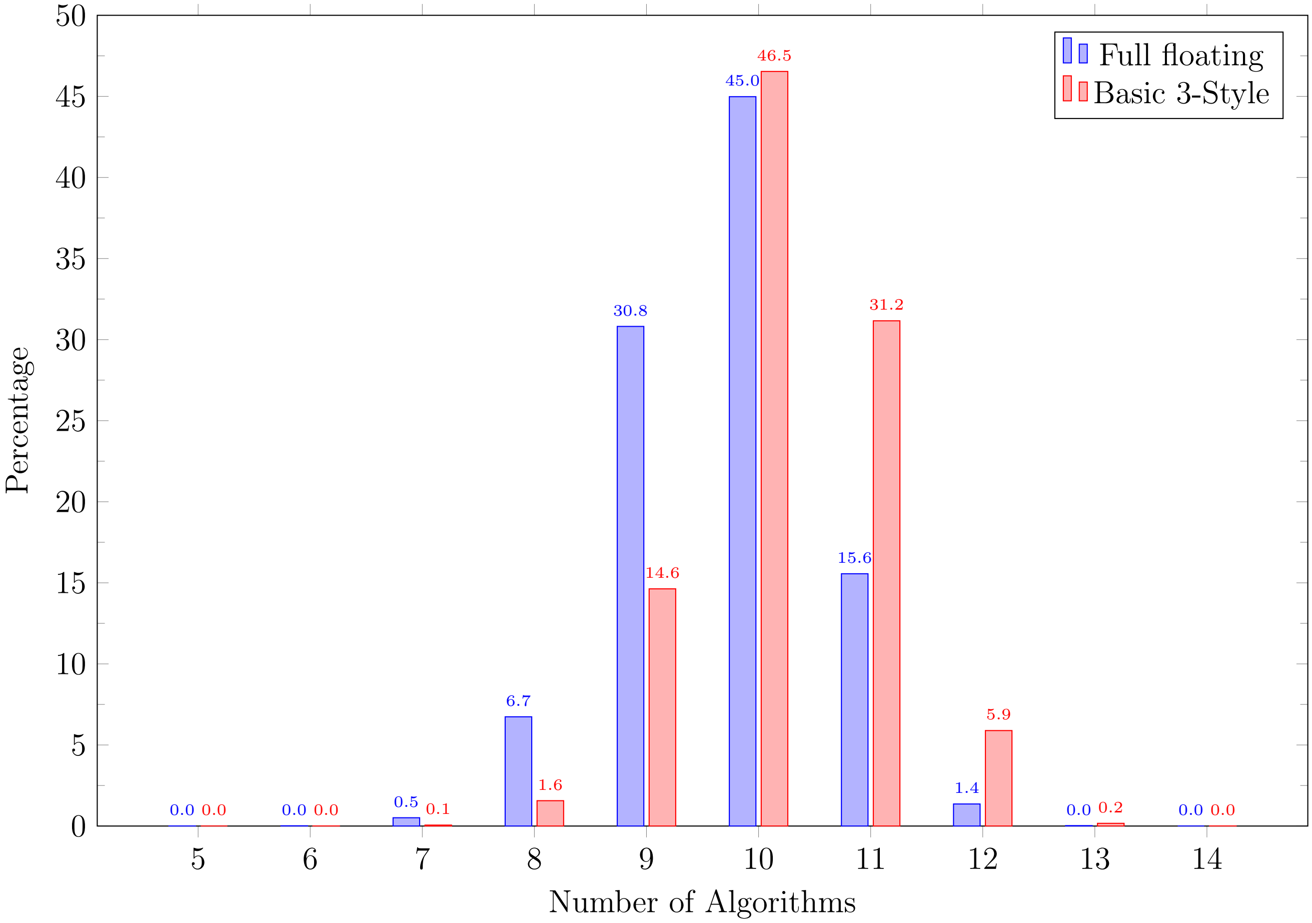
Table 4: Number of 3-Style Algorithms with Full Floating

	5	6	7	8	9
Percentage	0.0002%	0.014%	0.51%	6.74%	30.81%
Amount	1	71	2,582	34,052	155,740

	10	11	12	13	14
Percentage	44.98%	15.56%	1.36%	0.024%	0.0%
Amount	227,359	78,639	6,875	121	0

The 5 algorithm scramble is: F' U' D2 R U D2 R' U F' U R' L2 U2 L2 U B2 U2 F2 D' Rw'

Figure 4: Distribution of the 3-Style Algorithm Count with Full Floating



The average algorithm count is **9.72**

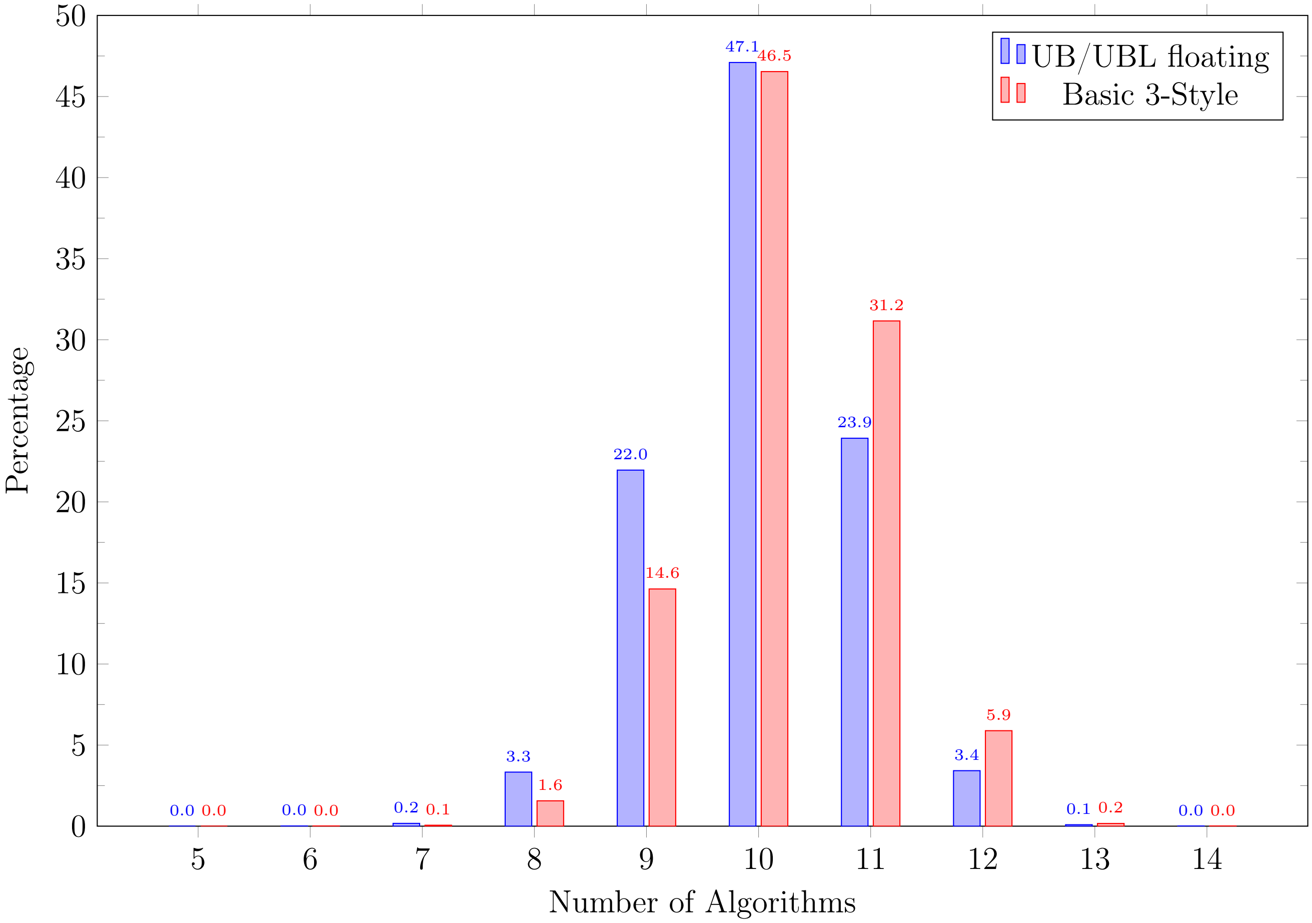
5 Number of Algorithms using only UB and UBL Floating

Now we wanted to find out how useful only one extra edge and one extra corner buffer would be. Although UBL is not the best buffer for floating we decided to choose it since the gerneral statistics of using one corner buffer don't change significantly. Furthermore UBL is used by a lot of cubers.

Table 5: Number of 3-Style Algorithms with UB and UBL Floating

	5	6	7	8	9	10	11	12	13	14
Percentage	0.0%	0.003%	0.17%	3.33%	21.96%	47.10%	23.93%	3.42%	0.089%	0.0004%
Amount	0	16	866	16,847	110,984	238,054	120,924	17,296	451	2

Figure 5: Distribution of the 3-Style Algorithm Count with UB and UBL Floating



The average algorithm count is **10.02**

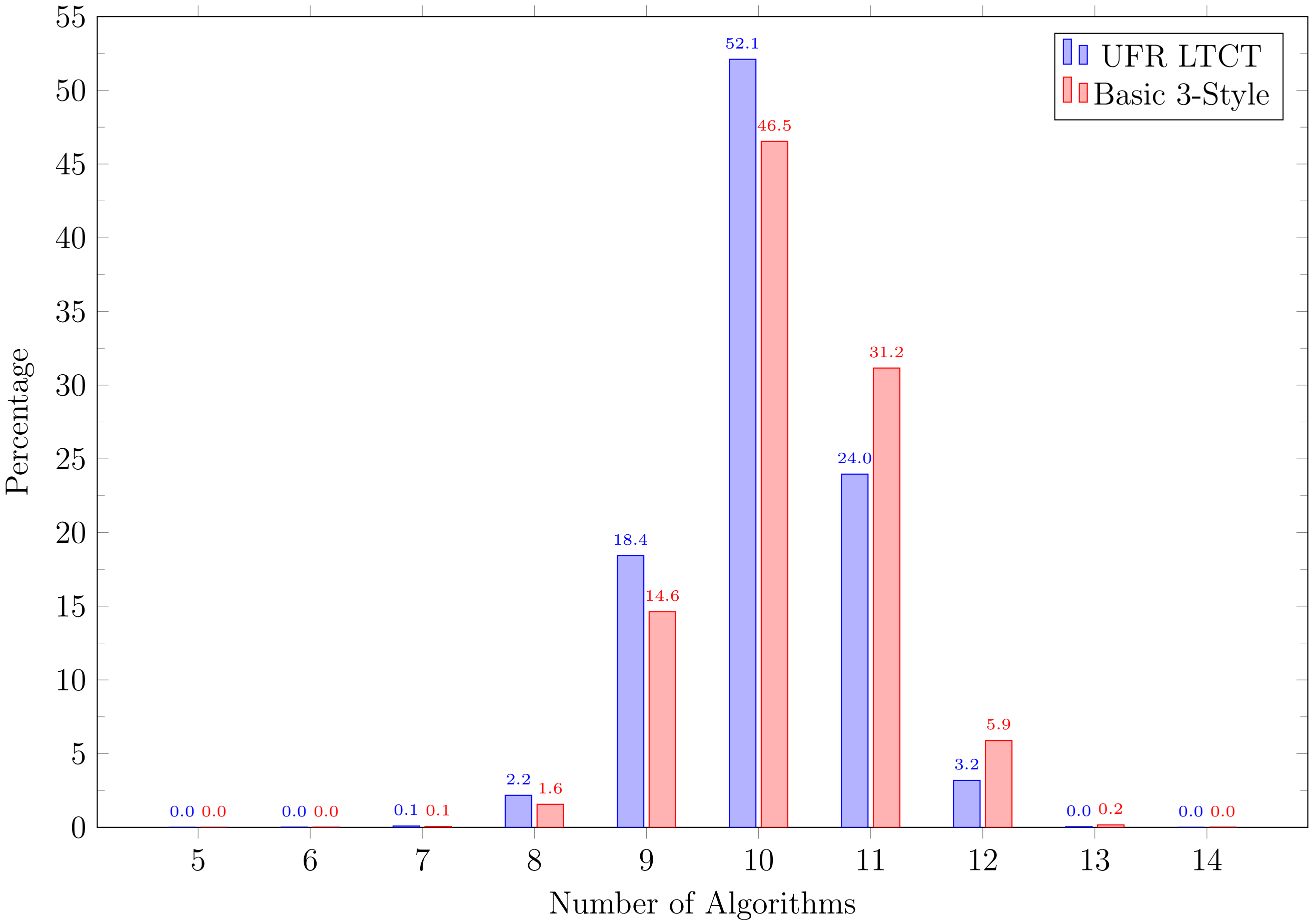
6 Number of Algorithms using Full UFR LTCT

For the following statistics we did not float and used all LTCT algorithms (252) from the UFR buffer with the standard UR-UF pseudo swap. LTCT was used not only to solve parity and one corner twist but also to reduce two alg twist cases to one alg cases.

Table 6: Number of 3-Style Algorithms with LTCT

	5	6	7	8	9	10	11	12	13	14
Percentage	0.0%	0.001%	0.088%	2.173%	18.442%	52.104%	23.962%	3.186%	0.044%	0.0%
Amount	0	6	444	10,984	93,213	263,356	121,112	16,105	220	0

Figure 6: Distribution of the 3-Style Algorithm Count with LTCT



The average algorithm count is **10.07**

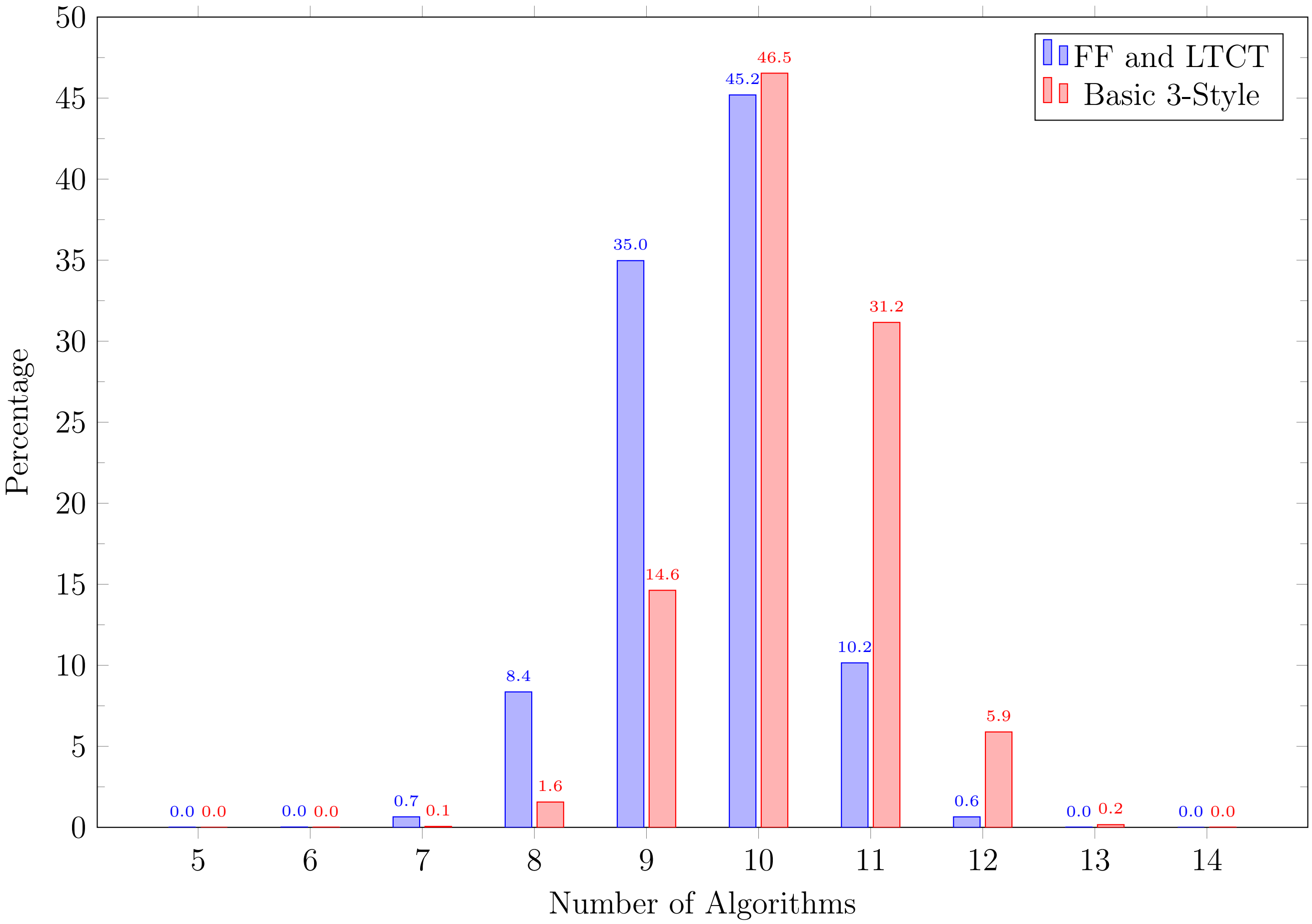
7 Number of Algorithms using Full Floating and Full LTCT

For this we assumed LTCT for all U layer buffers, as setups with U moves seem viable, but this assumption doesn't change a lot since this doesn't appear often.

Table 7: Number of 3-Style Algorithms with Full Floating and LTCT

	5	6	7	8	9	10	11	12	13	14
Percentage	0.0002%	0.019%	0.65%	8.36%	34.97%	45.20%	10.15%	0.65%	0.005%	0.0%
Amount	1	97	3,284	42,252	176,755	228,439	51,314	3,274	24	0

Figure 7: Distribution of the 3-Style Algorithm Count with Full Floating and LTCT



The average algorithm count is **9.58**

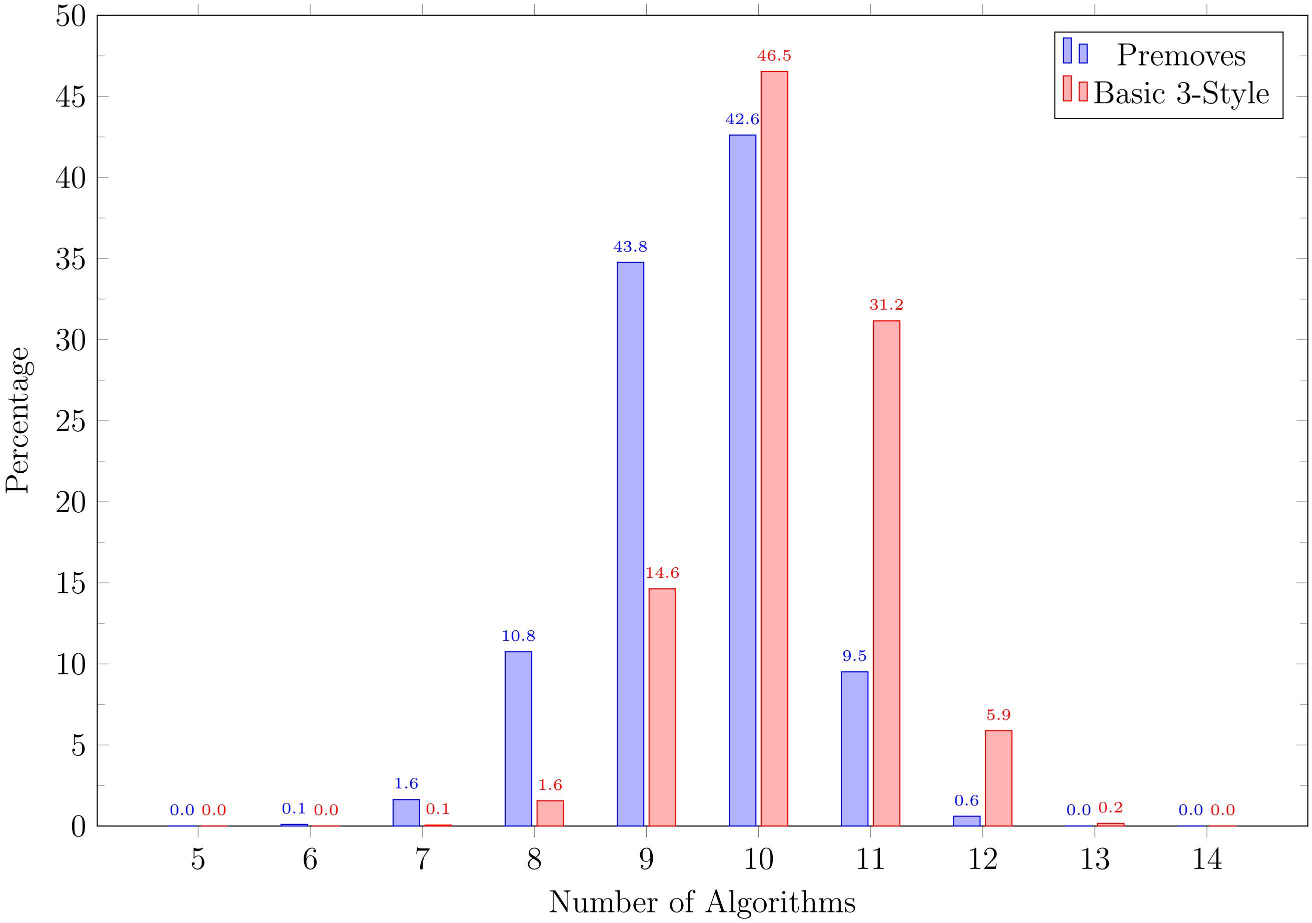
8 Number of Algorithms using Premoves, Full Floating and LTCT

We did at most one outer turn premove, if it solved three or more pieces compared to the original scramble.

Table 8: Number of 3-Style Algorithms with Premoves, FF and LTCT

	5	6	7	8	9	10	11	12	13	14
Percentage	0.003%	0.104%	1.63%	10.76%	34.78%	42.62%	9.51%	0.61%	0.005%	0.0%
Amount	15	526	8,254	54,366	175,724	215,409	48,059	3,063	24	0

Figure 8: Distribution of the 3-Style Algorithm Count with Premoves, FF and LTCT



The average algorithm count is **9.49**. The premove was used in **5.97**% of the scrambles.

9 Comparison

Figure 9: **6** Algers with Differnet Techniques in 505,440 Scrambles

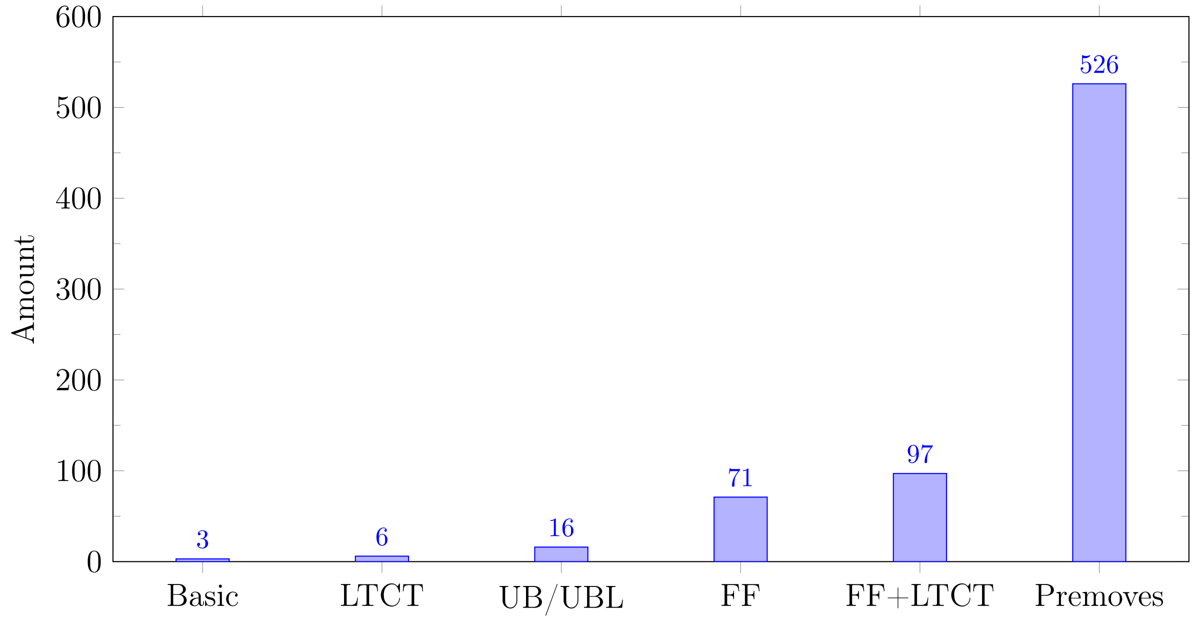


Figure 10: **7** Algers with Differnet Techniques in 505,440 Scrambles

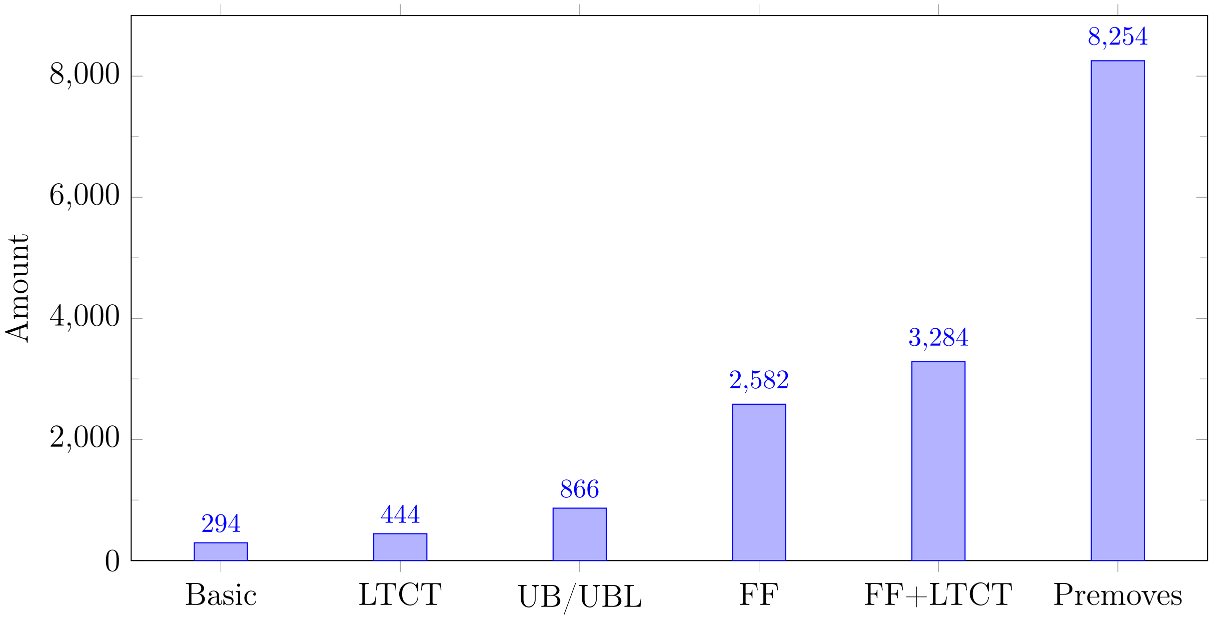


Figure 11: **8** Algers with Differnet Techniques in 505,440 Scrambles

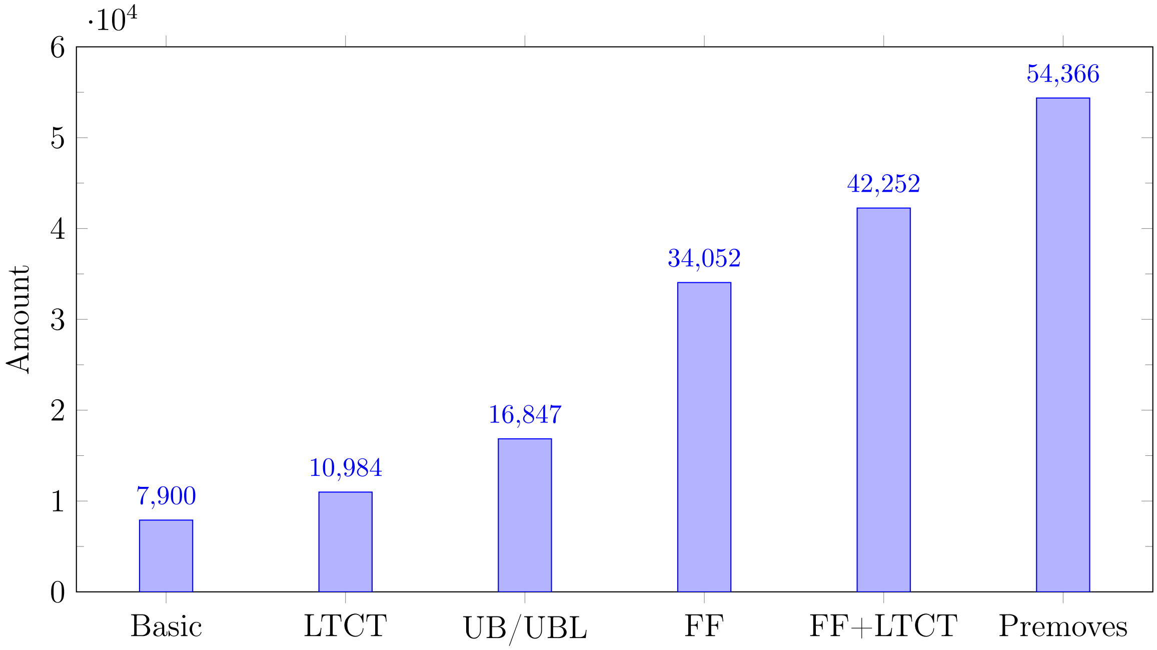


Figure 12: **9** Algers with Differnet Techniques in 505,440 Scrambles

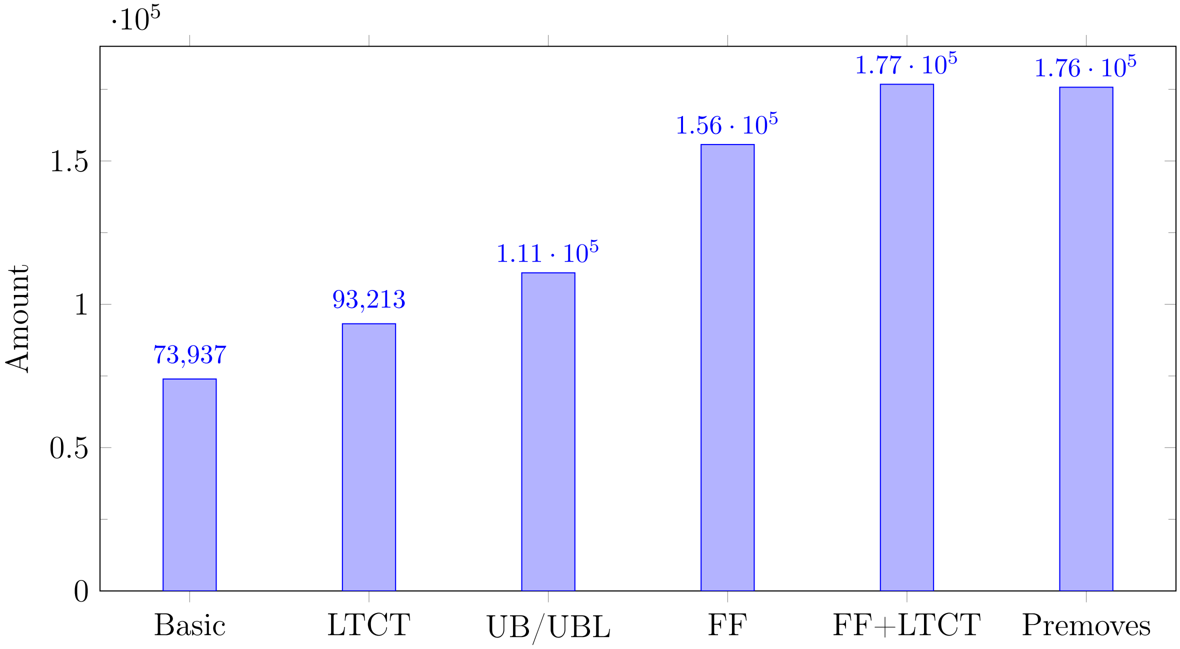


Figure 13: **10** Algers with Differnet Techniques in 505,440 Scrambles

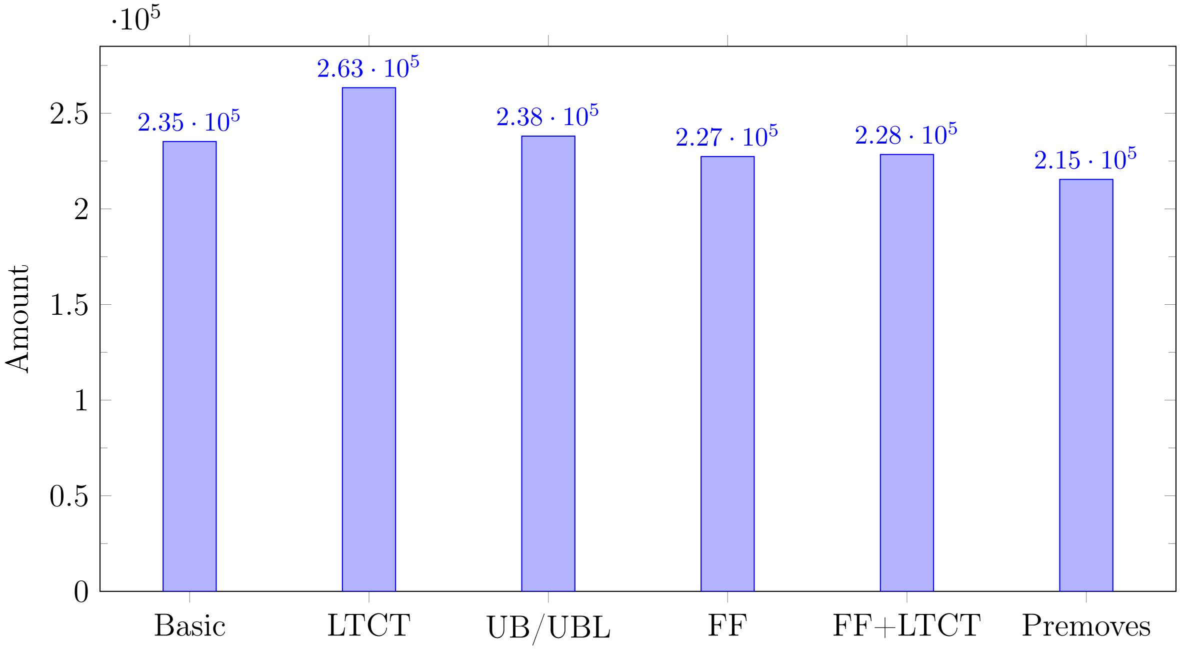


Figure 14: **11** Algers with Differnet Techniques in 505,440 Scrambles

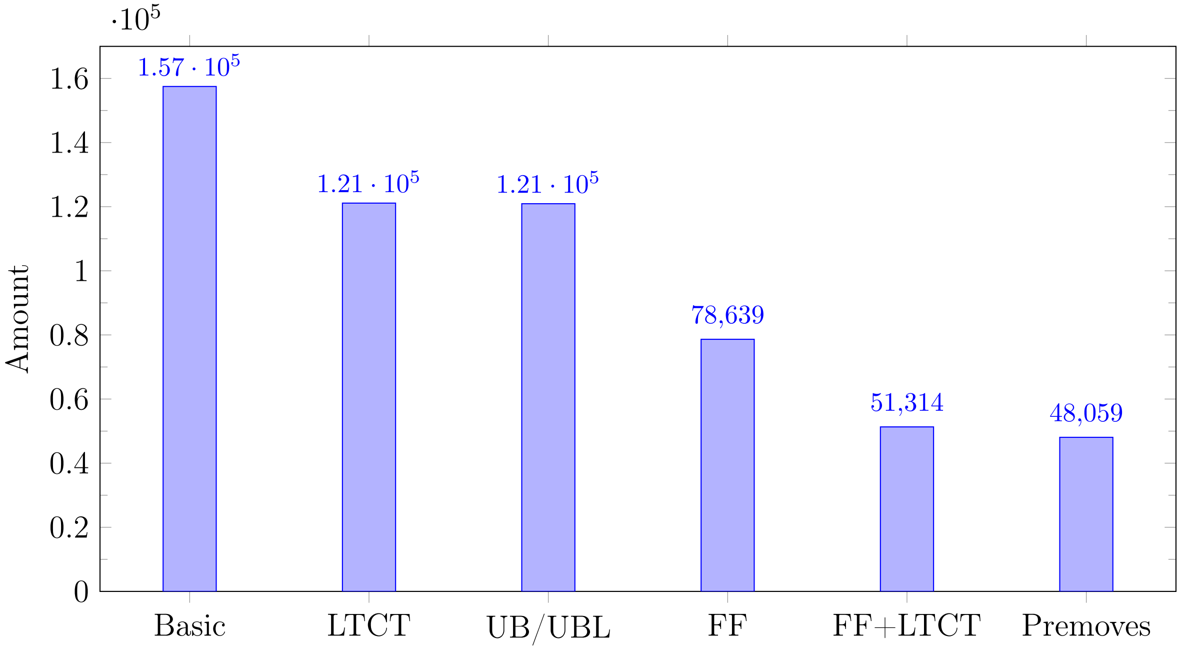


Figure 15: **12** Algers with Differnet Techniques in 505,440 Scrambles

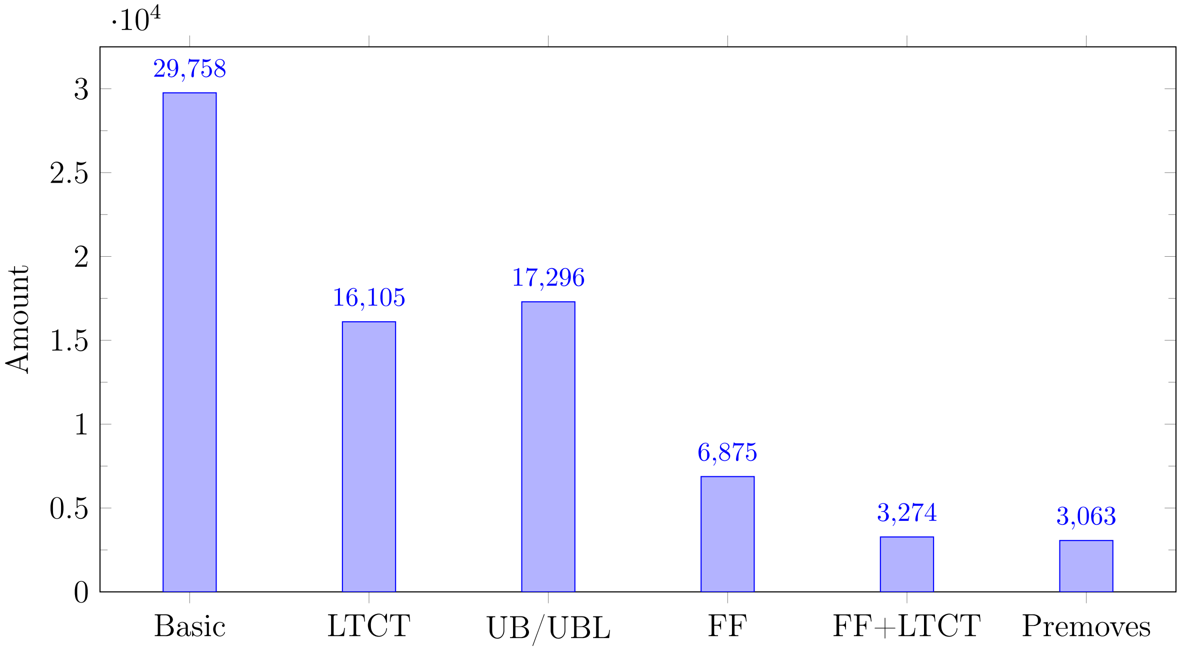
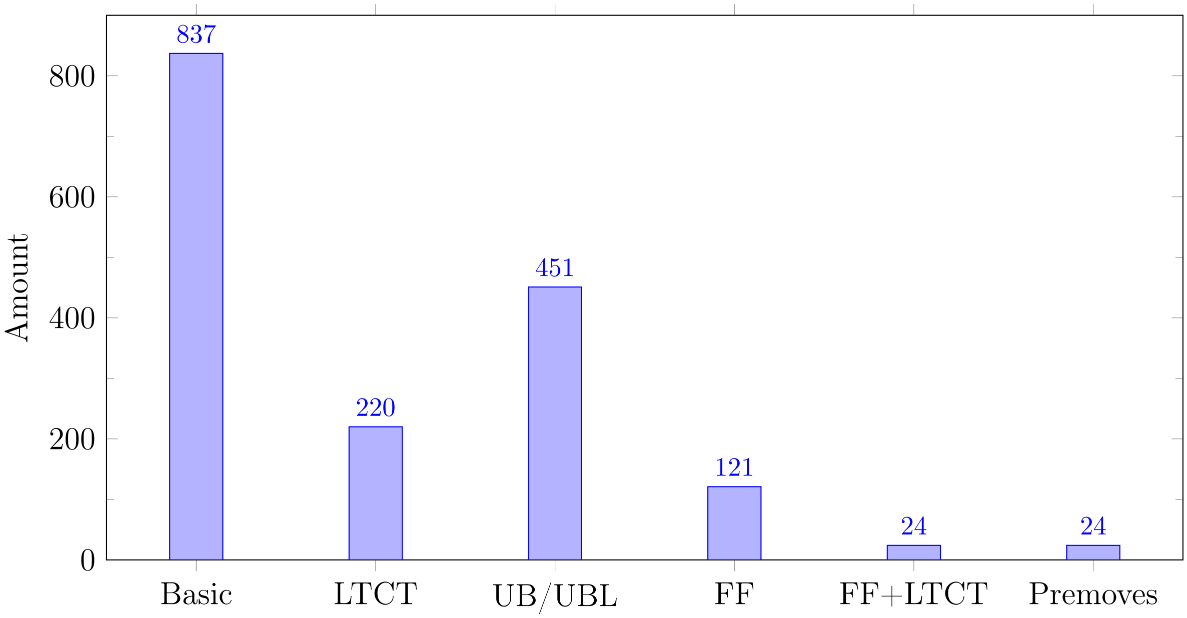


Figure 16: **13** Algers with Differnet Techniques in 505,440 Scrambles



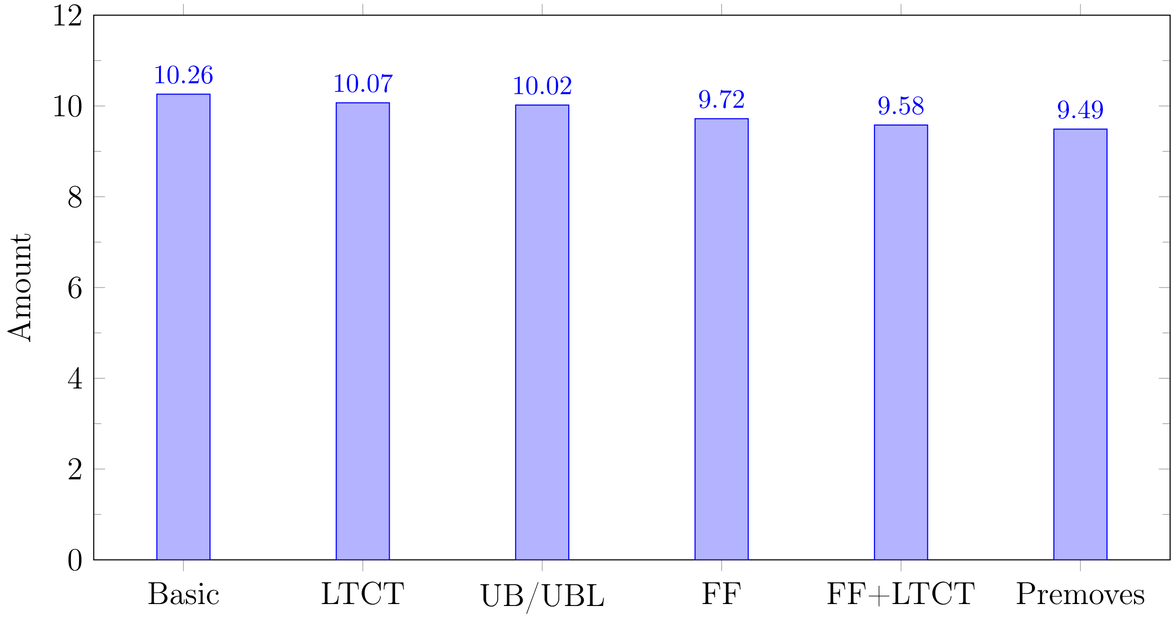
10 Summary and Conclusion

We detected parity in **50.03**% of the scrambles, which lies within half a standard deviation. On average **0.83** were solved, including the buffers. Excluding the buffers we had **0.458** edge flips and **0.584** corner twists per scramble. A viable premove was present in **5.97**% of the scrambles. Two floating buffers were almost as useful as all the additional buffers combined. While full foating and premoves produced a lot of very good scrambles, LTCT was efficient in reducing bad ones. In the following table we summarized the average algorithm count with the different techniques.

Table 9: Influence of the Different Techniques

	Basic	FF	UB/UBL F	LTCT	FF LTCT	Premoves
Average algs	10.26	9.72	10.02	10.07	9.58	9.49

Figure 17: Influence of the Different Techniques



One particularly interesting scramble:
B2 D U R2 D’ B2 U’ R’ D R2 F’ R2 U2 B F2 L’ D2 U Fw’ Uw’
Here it is possible to obtain a 4-alger by doing an F’ premove and an alternative pseudo swap.