TABLE I
COMPARING *AutoCCAG* WITH *TCA-opt*, *TCA*, *CASA*, *HHSA* AND *CHiP* FOR 3-WAY CCAG ON THE REAL-WORLD AND IBM BENCHMARKS. THE RUN TIME IS MEASURED IN SECOND.

Instance	*AutoCCAG*		*TCA-opt*		*TCA*		*CASA*		*HHSA*		*CHiP*	
	min (avg)	time	min (avg)	time	min (avg)	time	min (avg)	time	min (avg)	time	size	time
Apache	**132 (136.7)**	732	141 (143.7)	848	154 (155.5)	896	245 (247.9)	874	– (–)	>1000	166	90947
Bugzilla	**48 (48.0)**	6	**48 (48.0)**	9	**48 (48.0)**	9	61 (64.6)	33	61 (64.3)	122	54	4218
GCC	**73 (75.3)**	757	80 (82.4)	798	81 (83)	894	112 (140)	894	– (–)	>1000	91	28671
SPIN-S	**80 (80.0)**	<1	**80 (80.0)**	1	**80 (80.0)**	3	98 (100.5)	4	81 (93.5)	12	93	1899
SPIN-V	**190 (192.9)**	900	198 (199.5)	19	198 (200.5)	219	224 (233.1)	671	210 (214)	663	205	1513
Banking1	**45 (45.0)**	<1	**45 (45.0)**	1	**45 (45.0)**	<1	**45** (46.2)	<1	**45 (45.0)**	<1	**45**	378
Banking2	**30 (30.0)**	<1	**30 (30.0)**	<1	**30 (30.0)**	<1	**30** (30.4)	<1	**30 (30.0)**	<1	**30**	142
CommProtocol	**41 (41.0)**	<1	**41 (41.0)**	2	**41 (41.0)**	1	**41** (42.2)	<1	**41** (41.3)	9	50	5846
Concurrency	**8 (8.0)**	<1	**8 (8.0)**	<1	**8 (8.0)**	<1	**8 (8.0)**	<1	**8 (8.0)**	<1	**8**	215
Healthcare1	**96 (96.0)**	<1	**96 (96.0)**	<1	**96 (96.0)**	<1	**96** (96.6)	<1	**96 (96.0)**	6	103	1323
Healthcare2	**51 (51.7)**	127	**51** (51.9)	193	**51** (51.9)	215	53 (55.1)	6	53 (53.8)	3	52	524
Healthcare3	**146 (149.3)**	590	153 (154.4)	334	154 (154.9)	381	170 (175)	228	168 (176.5)	98	171	1676
Healthcare4	**238 (238.4)**	368	239 (241.1)	553	240 (241.4)	606	278 (286.7)	890	281 (287.8)	306	257	6927
Insurance	**6851 (6851.0)**	<1	**6851 (6851.0)**	3	**6851 (6851.0)**	11	7017 (7156.4)	760	– (–)	>1000	**6851**	115809
NetworkMgmt	**1100 (1100.0)**	<1	**1100 (1100.0)**	1	**1100 (1100.0)**	<1	1124 (1136.8)	5	**1100 (1100.0)**	58	**1100**	4523
ProcessorComm1	**103 (104.9)**	229	105 (105.5)	275	108 (108.4)	292	117 (120.7)	81	115 (120.3)	9	119	383
ProcessorComm2	**120 (122.8)**	217	125 (126.3)	354	126 (126.9)	377	141 (145.0)	233	138 (144.6)	198	164	2675
Services	**815 (817.5)**	283	840 (845.8)	116	842 (847.2)	145	853 (894)	442	825 (831.7)	314	942	37540
Storage1	**25 (25.0)**	<1	**25 (25.0)**	<1	**25 (25.0)**	<1	**25 (25.0)**	<1	**25 (25.0)**	1	**25**	1074
Storage2	**54 (54.0)**	<1	**54 (54.0)**	<1	**54 (54.0)**	<1	**54** (55.8)	<1	**54 (54.0)**	2	**54**	23
Storage3	**222 (222.0)**	3	**222 (222.0)**	7	**222 (222.0)**	8	241 (248.8)	2	225 (225.9)	76	233	6076
Storage4	**910 (910.0)**	8	**910 (910.0)**	29	**910 (910.0)**	34	927 (951.6)	712	**910** (910.8)	273	–[a]	–[a]
Storage5	**1705 (1707.1)**	615	1707 (1708.4)	636	1709 (1711.5)	773	1856 (1958.3)	972	– (–)	>1000	1879	35538
SystemMgmt	**45 (45.0)**	<1	**45 (45.0)**	<1	**45 (45.0)**	1	47 (48.3)	<1	**45** (45.9)	2	50	173
Telecom	**120 (120.0)**	<1	**120 (120.0)**	<1	**120 (120.0)**	<1	**120** (120.4)	<1	**120 (120.0)**	2	**120**	1043

[a] As originally reported in the literature [1], *SQ-CHiP* finds a CCA with the size of 819 with the running time of 11029 seconds on instance 'Storage4'. However, for solving 3-way CCAG, the model files for 'Storage4' adopted in our work and in the literature [1] are not exactly the same. Thus we mark '–' for the result of *SQ-CHiP* on 'Storage4' in this table. Nevertheless, we have performed 10 independent runs of *AutoCCAG* on 'Storage4' as used in the literature [1], and all 10 runs can find CCAs with the size of 819 in 600 seconds.

References:

[1] H. Mercan, C. Yilmaz, and K. Kaya, "CHiP: A configurable hybrid parallel covering array constructor," IEEE Transactions on Software Engineering, vol. 45, no. 12, pp. 1270–1291, 2019.