


# ICCAD-2020 CAD contest in Routing with Cell Movement

Problem Description, Benchmarks, and Results

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# Outline

- Problem Description
- Evaluation Methodology
- Benchmarks
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# Problem Description

- Objective
  - Placement and Routing divide-and-conquer approach would introduce
    - conservative margin reservation and mis-correlation between stages
- Develop a global route routing engine
  - Honor all given constraints
  - Can move cells from one gGrid to another gGrid
  - Max number of cell moves would be given
  - Optimize total routing length

# Problem Description

- Given
  - Max number of cell moves
  - Layer and gGrid information
  - Master cell information
  - Extra demands constraint
  - Netlist and the cell instance information
  - Net-based min routing layer constraint
  - An initial routing result
- Output
  - Moved cells
  - Final routing result
- Challenges
  - Routing and placement fusion
  - Demand constraint
  - net-based min routing layer constraint
- Multi-threading is encouraged

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# Evaluation Methodology

- Score
  - summation of the routing length reduction of all the nets
  - The score of each case would be summed up as the final ranking of this contest
- Evaluator is provided
  - Usage
    - `./evaluator <input.txt> [<output.txt>]`

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- Results



# Benchmarks

- Public cases

	case1	case2	case3	case4	case5	case6
#gGrids	5x5	4x4	27x33	277x277	104x103	237x236
#Layers	3	3	7	12	16	16
#CellInsts	8	6	2735	204206	96682	352269
#Nets	6	6	2644	179996	92546	332080
initial #routes	42	20	26046	3530382	1404555	4575644
initial total gGrid length	64	30	32600	4680681	1763627	7188481

- Hidden cases

	case3B	case4B	case5B	case6B
#gGrids	29x29	277x277	104x103	237x236
#Layers	7	12	16	16
#CellInsts	2604	207347	96689	352234
#Nets	2563	183137	92559	332045
initial #routes	24829	3661438	1368552	4685372
initial total gGrid length	29748	4886698	1721530	7340802

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# Results – Top X

## Alpha to Beta

- Alpha

Rank	case1	case2	case3	case4	case5	case6	case3B	case4B	case5B	case6B
1	35	7	10219	1484034	408748	N/A	10101	1540600	392690	N/A
2	30	7	6495	1260077	235792	N/A	6651	1280465	231378	N/A
3	25	4	6375	0	0	N/A	6450	0	0	N/A
4	21	4	6107	0	0	N/A	3990	0	0	N/A
5	17	0	4987	0	0	N/A	0	0	0	N/A

- Beta

Rank	case1	case2	case3	case4	case5	case6	case3B	case4B	case5B	case6B
1	35	10	11315	1955041	672460	2498198	11149	2073264	644785	2467195
2	35	10	10620	1951162	613501	2467195	10557	2064108	589435	2463763
3	31	7	9907	1730809	488004	2205217	10029	1822979	466238	2207586
4	30	7	8375	1627434	447627	1984997	8849	1699778	410345	1978404
5	29	7	7330	1592186	425676	737927	7748	1653170	398524	743795

# Results – Top X

## Beta to Final

- Beta

Rank	case1	case2	case3	case4	case5	case6	case3B	case4B	case5B	case6B
1	35	10	11315	1955041	672460	2498198	11149	2073264	644785	2467195
2	35	10	10620	1951162	613501	2467195	10557	2064108	589435	2463763
3	31	7	9907	1730809	488004	2205217	10029	1822979	466238	2207586
4	30	7	8375	1627434	447627	1984997	8849	1699778	410345	1978404
5	29	7	7330	1592186	425676	737927	7748	1653170	398524	743795

- Final

Rank	case1	case2	case3	case4	case5	case6	case3B	case4B	case5B	case6B
1	35	10	11557	2048105	695219	2721274	11289	2182574	664347	2748097
2	35	10	11428	2046811	685173	2687926	11237	2180172	654797	2722222
3	35	7	11425	2037598	682963	2656320	11131	2167411	654183	2668052
4	34	7	11368	1976434	666445	2557851	11073	2085157	639185	2539645
5	33	7	10397	1912754	631258	2513353	10196	2019382	602135	2506891

# Results – Changing % of the max cell moves

case4	%	cada0096	cada0154	cada0180	cada0191
	0	1620939	1589041	1535077	1616834
	5	1759193	1729535	1728243	1751138
	10	1847369	1810247	1826937	1832899
	<b>30</b>	<b>2046811</b>	<b>1976434</b>	<b>2048105</b>	<b>2037598</b>
	100	2105204	2001447	2130224	2096109

case4B	%	cada0096	cada0154	cada0180	cada0191
	0	1685355	1648083	1596997	1681222
	5	1841257	1794016	1810729	1835012
	10	1944557	1880502	1921176	1926593
	<b>30</b>	<b>2182574</b>	<b>2085157</b>	<b>2180172</b>	<b>2167411</b>
	100	2272142	2142420	2299913	2260482

case5	%	cada0096	cada0154	cada0180	cada0191
	0	444402	430270	430164	432470
	5	523406	508237	512105	508965
	10	575423	555866	565653	561209
	<b>30</b>	<b>695219</b>	<b>666445</b>	<b>685173</b>	<b>682963</b>
	100	708931	700177	707991	703189

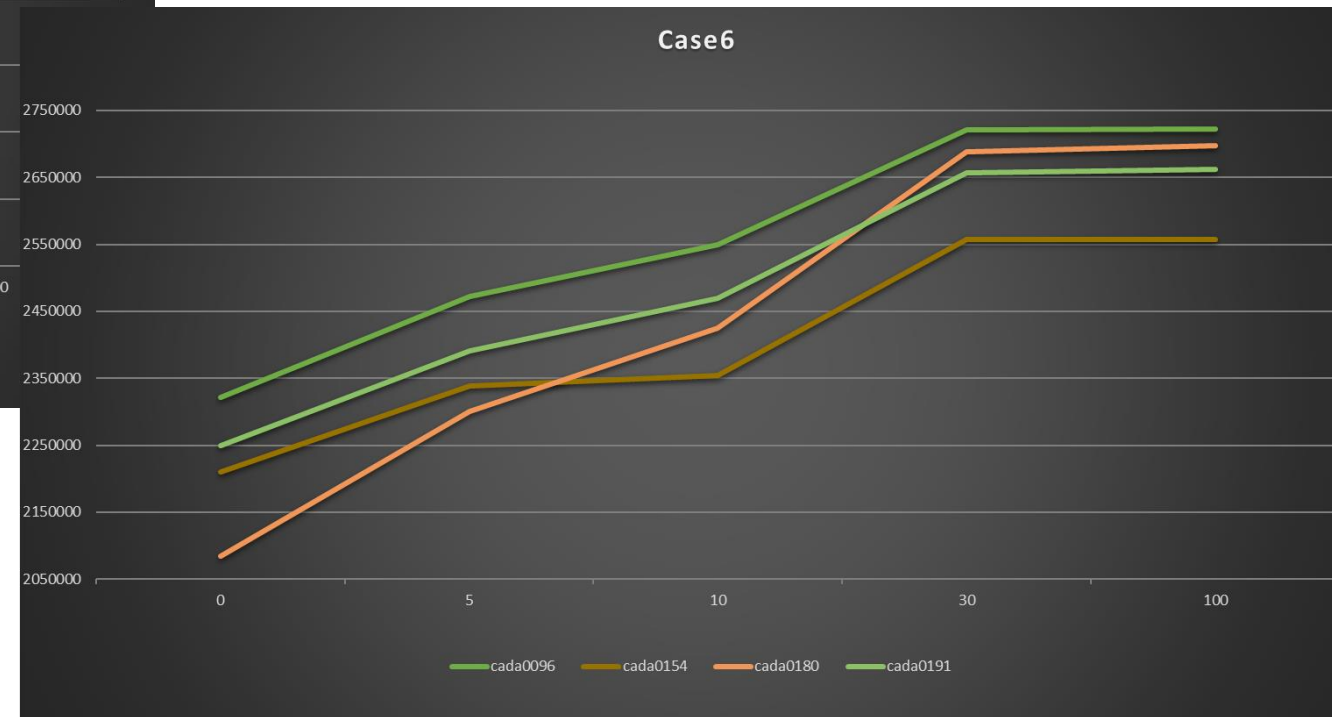
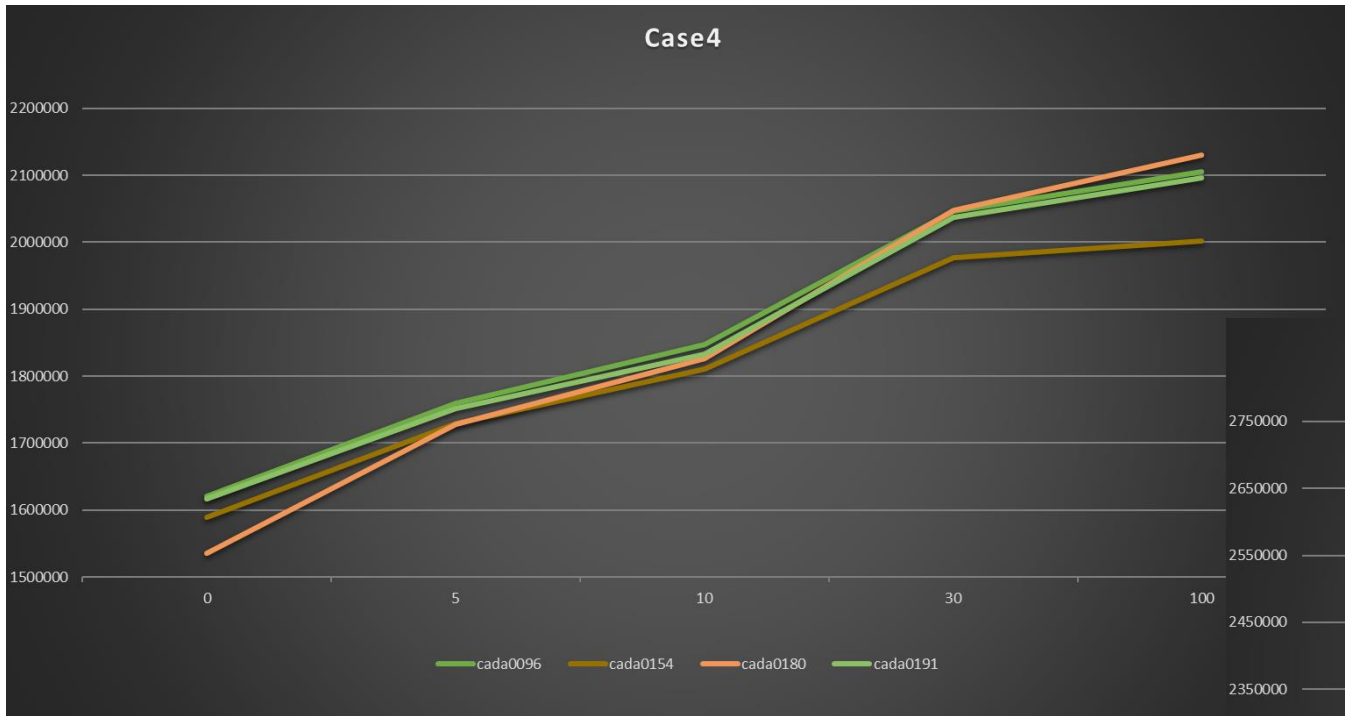
case5B	%	cada0096	cada0154	cada0180	cada0191
	0	427891	413626	412512	416396
	5	503328	489144	492317	489923
	10	553787	535999	542505	539195
	<b>30</b>	<b>664347</b>	<b>639185</b>	<b>654797</b>	<b>654183</b>
	100	671279	664752	670606	666946

case6	%	cada0096	cada0154	cada0180	cada0191
	0	2321123	2210058	2083923	2248789
	5	2471651	2338649	2300545	2391429
	10	2549427	2354639	2425577	2469308
	<b>30</b>	<b>2721274</b>	<b>2557851</b>	<b>2687926</b>	<b>2656320</b>
	100	2722281	2557851	2697533	2661884

case6B	%	cada0096	cada0154	cada0180	cada0191
	0	2342073	2202600	2105360	2256332
	5	2494105	2328110	2302974	2391085
	10	2573564	2410957	2443701	2475922
	<b>30</b>	<b>2748097</b>	<b>2539645</b>	<b>2722222</b>	<b>2668052</b>
	100	2748097	2539645	2722222	2673991

# Results – Changing % of the max cell moves

## Examples



# Results – Runtime

- Elapsed time

	case3	case4	case5	case6	case3B	case4B	case5B	case6B
cada0096	34s	37m01s	15m03s	52m51s	31s	38m19s	14m46s	56m46s
cada0154	34m25s	60m00s	60m00s	60m00s	42m00s	60m00s	60m00s	60m00s
cada0180	4s	13m24s	3m03s	36m57s	4s	13m6s	3m57s	46m41s
cada0191	1m51s	57m21s	20m13s	58m31s	3m26s	56m11s	20m26s	58m34s

# Top 3 Teams





# Third Place

Team cada0191

Xidian University

Benzheng Li

Jingchong Zhang

Qi Du

Xiyi He

Prof. Zhongdong Qi

Prof. Hailong You

# Second Place

Team cada0180

Fudan University, Fuzhou University

Peng Zou

Zhifeng Lin

Yongyi Guo

Yuxian Yue

Prof. Jianli Chen

Prof. Yingjie Wu

Prof. Jun Yu

# First Place

Team cada0096

The Chinese University of Hong Kong

Fangzhou Wang

Lixin Liu

Jingsong Chen

Jinwei Liu

Xinshi Zang

Prof. Evangeline F.Y. Young

# Thank You



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