**Table 4: Results of our analytical analog placement framework (NLP).**

| Design | NLP | | | | | | Device layer-aware NLP | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | area ($\mu m^2$) | | HPWL ($\mu m$) | | run-time (s) | | area ($\mu m^2$) | | HPWL ($\mu m$) | | run-time (s) | |
| | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. |
| opamp | 2973 | 1 | 753 | 1 | 17.1 | 1 | 2370 | 0.80 | 498 | 0.66 | 10.9 | 0.64 |
| $g_m$-C integrator | 182 | 1 | 73 | 1 | 1.2 | 1 | 175 | 0.96 | 60 | 0.83 | 1.2 | 1.00 |
| CTDSM | 57455 | 1 | 3129 | 1 | 6.5 | 1 | 56060 | 0.98 | 2580 | 0.82 | 6.5 | 1.00 |
| average | | 1 | | 1 | | 1 | | 0.91 | | 0.77 | | 0.88 |

**Table 5: Results of MILP-based placement with quality matching (MILP-Q), and run-time matching (MILP-R) our framework without device layer-awareness (NLP).**

| Design | NLP | | | | | | MILP-Q | | | | | | MILP-R | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | area ($\mu m^2$) | | HPWL ($\mu m$) | | run-time (s) | | area ($\mu m^2$) | | HPWL ($\mu m$) | | run-time (s) | | area ($\mu m^2$) | | HPWL ($\mu m$) | | run-time (s) | |
| | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. | actual | norm. |
| opamp | 2973 | 1 | 753 | 1 | 17.1 | 1 | 3295 | 1.11 | 714 | 0.95 | 607.2 | 35.57 | 4181 | 1.41 | 927 | 1.23 | 20.2 | 1.19 |
| $g_m$-C integrator | 182 | 1 | 73 | 1 | 1.2 | 1 | 187 | 1.03 | 69 | 0.95 | 20.7 | 17.21 | 184 | 1.01 | 77 | 1.06 | 5.7 | 4.73 |
| CTDSM | 57455 | 1 | 3129 | 1 | 6.5 | 1 | 57960 | 1.01 | 3611 | 1.15 | 20.5 | 3.16 | 64472 | 1.12 | 3443 | 1.10 | 10.5 | 1.62 |
| average | | 1 | | 1 | | 1 | | 1.05 | | 1.02 | | 18.65 | | 1.18 | | 1.13 | | 2.51 |

**Table 6: Global routing (GR) results for the proposed analytical placement framework (NLP).**

| wirelength ($\mu$m) | NLP + GR | | Device layer-aware NLP + GR | |
|---|---|---|---|---|
| | actual | norm. | actual | norm. |
| opamp | 839 | 1 | 617 | 0.74 |
| $g_m$-C integrator | 89 | 1 | 79 | 0.89 |
| CTDSM | 3591 | 1 | 3034 | 0.84 |
| average | | 1 | | 0.82 |

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