Online Supplement of the Paper "Optimizing Inspection Schedules and Routes for Infrastructure Monitoring under Stochastic Decision-dependent Failures"

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1 Algorithms

2 Additional computational results

Table 1: Computational time and optimality gap of methods on described instances

Instance	$\frac{\lvert K\rvert}{\lvert N\rvert}$	$\frac{Q\lvert K\rvert}{\lvert N\rvert}$	Gurobi Time (s)	Gurobi Gap (%)	Greedy Time (s)	Greedy Gap (%)	Scenario decomposition Time (s)	Scenario decomposition Gap (%)
G-10-30	0.15	1.0	8.2	-	0.5	37.5	16.1	0.10
	0.15	1.5	9.3	-	1.0	27.8	19.3	0.12
	0.25	1.0	9.9	-	2.2	43.6	15.9	0.15
	0.25	1.5	10.9	-	2.7	49.3	19.5	0.14
	0.35	1.0	12.2	-	4.6	51.2	16.5	0.09
	0.35	1.5	11.8	-	5.1	49.7	20.3	0.12
G-20-75	0.15	1.0	520.3	-	1.4	51.0	153.5	0.06
	0.15	1.5	600.4	-	1.6	48.9	291.3	0.17
	0.25	1.0	650.2	-	1.8	35.7	164.3	0.23
	0.25	1.5	710.5	-	2.3	39.9	313.6	0.19
	0.35	1.0	720.9	-	2.1	37.8	174.8	0.08
	0.35	1.5	740.7	-	2.5	44.8	319.1	0.13
IEEE-33-136	0.15	1.0	1200.0	-	15.5	23.9	395.8	0.19
	0.15	1.5	1240.2	-	17.9	33.6	450.2	0.04
	0.25	1.0	1313.8	-	20.2	23.0	402.1	0.06
	0.25	1.5	1277.9	-	23.4	33.5	449.1	0.18
	0.35	1.0	1335.0	-	26.4	40.3	401.9	0.12
	0.35	1.5	1360.9	-	28.4	38.6	455.3	0.21
IEEE-123-556	0.15	1.0	6013.9	-	353.7	110.5	1212.4	2.50
	0.15	1.5	7031.5	-	360.3	95.2	1406.2	1.75
	0.25	1.0	6309.1	-	340.2	220.3	1220.3	2.10
	0.25	1.5	7207.5	-	390.5	170.5	1404.1	1.90
	0.35	1.0	7453.2	-	440.2	210.5	1230.0	3.02
	0.35	1.5	8204.6	-	494.7	190.2	1430.5	2.50

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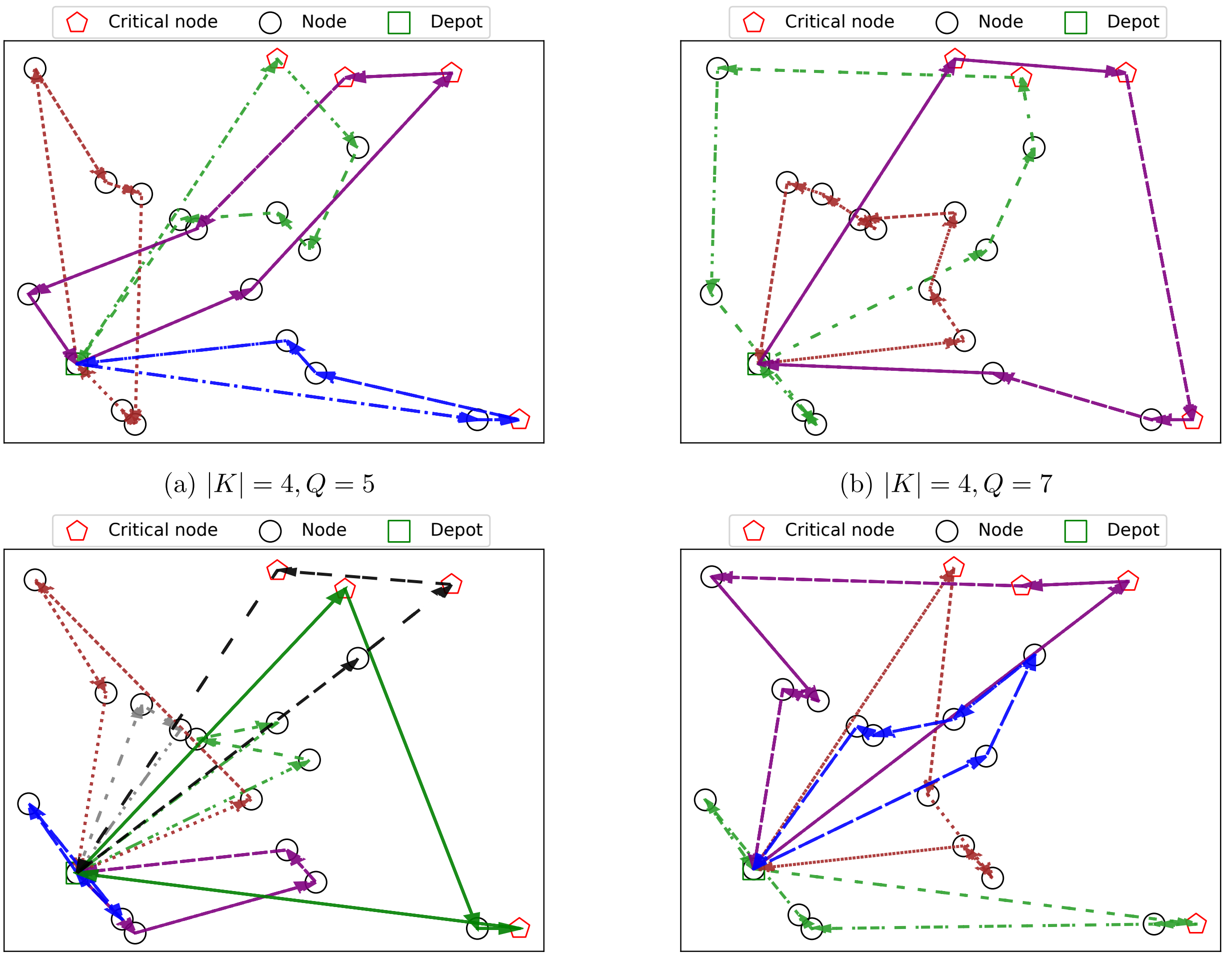
Algorithm 1 Random coloring algorithm (Yu et al., 2022)

Network $G = (N, E)$, color coding ϕ, iteration budget maxIter, number of solutions to early stop nSol, evaluated solution set S, dual optimal solution π.
Initialization $T = \emptyset$ as candidate solution set, $k = 0$
while $k <$ maxIter or $|T| <$ nSol **do**
  Generate a random coloring function $\phi_k : N \to \{1, \ldots, Q\}$
  Initialize $\Lambda_{\text{depot}} \leftarrow \{0 \ldots, 0\}$
  for $i \in N$ **do**
    $\Lambda_i \leftarrow \emptyset$
  end for
  $B = \{\text{depot}\}$
  while $B \neq \emptyset$ **do**
    Sample $i \in B$
    if $i =$ depot **then**
      Add corresponding routes from Λ_{depot} with negative cost to T
    else
      for $j : (i, j) \in E$ **do**
        for $\lambda_i = (R_i, C_i) \in \Lambda_i$, with $R_i = (n_i, N_i^1, \ldots, N_i^Q)$ **do**
          if $N_i^{\phi(j)} = 0$ **then**
            Extend λ_i to obtain λ_j
            if $\lambda_j \notin S$ **then**
              if λ_j is not dominated by any path in Λ_j **then**
                Add λ_j to Λ_j and $B = B \cup \{j\}$
                Remove any path in Λ_j that is dominated by λ_j
              end if
            end if
          end if
        end for
      end for
    end if
    Remove i from B
  end while
  Add routes with negative cost to T
  $k = k + 1$
end while
Return T



(a) $|K| = 4, Q = 5$

(b) $|K| = 4, Q = 7$

(c) $|K| = 7, Q = 3$

(d) $|K| = 7, Q = 5$

Figure 1: Optimal routes for 20% of critical nodes

References

Yu, M., Nagarajan, V., and Shen, S. (2022). Improving column generation for vehicle routing problems via random coloring and parallelization. *INFORMS Journal on Computing*, 34(2):953–973.