

ERRATUM: VALIDATED LINEAR RELAXATIONS AND PREPROCESSING: SOME EXPERIMENTS*

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Abstract. This is a correction to R. B. Kearfott and S. Hongthong’s article [*SIAM J. Optim.*, 16 (2005), pp. 418–433].

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There are errors in column 4 (entitled “Under / over estimators”) of rows 3, 4, and 5 of Table 4.1, on p. 426 of [1]. As a consequence, references to those entries in the table on lines 1 and 2 below the table (on page 426) and on lines 5, 6, 7, and 8 of section 4.1 are incorrect, and the last line of that paragraph should be deleted. The error occurred by using the wrong enclosure range. For example, the midpoint of the enclosure range $[-3, 1]$ for v_4 , namely $v_4 = -1$, should have been used in the tangent line for row 3, whereas the midpoint of the enclosure range for $v_5 = v_4^2$ had been used instead. Similar errors occurred in rows 4 and 5.

Table 4.1 should therefore be corrected to read as follows:

#	Operation	Enclosures	Under/over estimators	Convexity
1	$v_3 \leftarrow x_1 + x_2$	$[-2, 2]$	$x_1 + x_2 - v_3 = 0$	linear
2	$v_4 \leftarrow v_3 - 1$	$[-3, 1]$	$v_3 - 1 - v_4 = 0$	linear
3	$v_5 \leftarrow v_4^2$	$[0, 9]$	$(-1)^2 + 2(-1)(v_4 - (-1)) - v_5 \leq 0$	convex
4	$v_6 \leftarrow x_1^2$	$[0, 1]$	$(0)^2 + 2(0)(v_1 - 0) - v_6 \leq 0$ $1 - v_6 \geq 0$	convex <u>nonconvex</u>
5	$v_7 \leftarrow x_2^2$	$[0, 1]$	$(0)^2 + 2(0)(v_2 - 0) - v_7 \leq 0$ $1 - v_7 \geq 0$	convex <u>nonconvex</u>
6	$v_8 \leftarrow v_6 + v_7$	$[0, 2]$	$v_6 + v_7 - v_8 = 0$	linear
7	$v_9 \leftarrow v_8 - 1$	$[-1, 1]$	$v_8 - 1 - v_9 = 0$	linear
8	$v_{10} \leftarrow -v_9^2$	$[-1, 0]$	$-1 - v_{10} \leq 0$	<u>nonconvex</u>
9	$v_{11} \leftarrow v_5 + v_{10}$	$[-1, 9]$	$v_5 + v_{10} - v_{11} \leq 0$	linear

Thus, lines 1 and 2 below Table 4.1 should read as follows:

enclosure interval; for example, the expression $(-1)^2 + 2(-1)(v_4 - (-1))$ in the third row corresponds to the tangent line to v_4^2 at $v_4 = -1$. The nonconvex operations $(-v_9^2$,

Since the data were no longer correct, the last sentence of the paragraph above section 4.1 should be deleted. (The reader may solve the corrected linear program with any method.)

Similarly, the first paragraph of section 4.1 (in which lines 5, 6, 7, and 8 are changed) should read as follows:

4.1. Refining convex constraints. As explained in [23, section 4.2] and elsewhere, the nonlinear convex operations can be approximated more closely in the linear relaxation by appending more constraints corresponding to additional tangent lines. For example, in the nonlinear convex operation $v_5 \leftarrow v_4^2$ in Example 1, in addition

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to the constraint $v_5 \geq (-1)^2 + (-2)(v_4 + 1)$ (corresponding to the tangent line at $v_4 = -1$), we may add the constraint $v_5 \geq (-2)^2 - 4(v_4 + 2)$ (corresponding to the tangent line at $v_4 = -2$) and the constraint $v_5 \geq (0)^2 + 0(v_4 - 0) = 0$ (corresponding to the tangent line at $v_4 = 0$), and any other similar tangent line. By spacing the tangent lines sufficiently close together, the corresponding convex constraint can be approximated arbitrary closely.

REFERENCES

- [1] R. B. KEARFOTT AND S. HONGTHONG, *Validated linear relaxations and preprocessing: Some experiments*, SIAM J. Optim., 16 (2005), pp. 418–433.