

Supplementary Materials: Description of subtree rejection rules

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1. Rules for 0 - 90 degree

- If the angle to the LEFT point is smaller than the MIN angle, reject the lower subtree.
 $\forall (x_l, y_l) : 0 < LA0 < \alpha < 90 \text{ reject } \{(x, y) : x \geq x_l; y \leq y_l\}$
- If the angle to the RIGHT point is greater than the MAX angle, reject the upper subtree.
 $\forall (x_r, y_r) : 90 > LA0 > \beta > 0 \text{ reject } \{(x, y) : x \leq x_r; y \geq y_r\}$
- If the angle to the UPPER point is smaller than the MIN angle, reject the right subtree.
 $\forall (x_u, y_u) : 0 < LA0 < \alpha < 90 \text{ reject } \{(x, y) : x \leq x_u; y \leq y_u\}$
- If the angle to the BOTTOM point is greater than the MAX angle, reject the left subtree.
 $\forall (x_b, y_b) : 90 > LA0 > \beta > 0 \text{ reject } \{(x, y) : x \leq x_b; y \geq y_b\}$

2. Rules for 90 - 180 degree

- If the angle to the LEFT point is smaller than the MIN angle, reject the upper subtree.
 $\forall (x_l, y_l) : 90 < LA0 < \alpha < 180 \text{ reject } \{(x, y) : x \geq x_l; y \geq y_l\}$
- If the angle to the RIGHT point is greater than the MAX angle, reject the lower subtree.
 $\forall (x_r, y_r) : 90 > \beta > LA0 > 180 \text{ reject } \{(x, y) : x \leq x_r; y \leq y_r\}$
- If the angle to the UPPER point is greater than the MAX angle, reject the left subtree.
 $\forall (x_u, y_u) : 90 < \beta < LA0 < 180 \text{ reject } \{(x, y) : x \leq x_u; y \leq y_u\}$
- If the angle to the BOTTOM is smaller than the MIN angle, reject the right subtree.
 $\forall (x_b, y_b) : 90 < LA0 < \alpha < 180 \text{ reject } \{(x, y) : x \geq x_b; y \geq y_b\}$

3. Rules for 180 - 270 degree

- If the angle to the LEFT point is greater than the MAX angle, reject the lower subtree.
 $\forall (x_l, y_l) : 180 > \beta > LA0 > 270 \text{ reject } \{(x, y) : x \geq x_l; y \leq y_l\}$
- If the angle to the RIGHT point is smaller than the MIN angle, reject the upper subtree.
 $\forall (x_r, y_r) : 180 < LA0 < \alpha < 180 \text{ reject } \{(x, y) : x \leq x_r; y \geq y_r\}$
- If the angle to the UPPER point is greater than the MAX angle, reject the right subtree.
 $\forall (x_u, y_u) : 180 > \beta > LA0 > 270 \text{ reject } \{(x, y) : x \geq x_u; y \leq y_u\}$
- If the angle to the BOTTOM point is smaller than the MIN angle, reject the left subtree.
 $\forall (x_b, y_b) : 90 < LA0 < \alpha < 180 \text{ reject } \{(x, y) : x \leq x_b; y \geq y_b\}$

4. Rules for 270 - 360 degree

- If the angle to the LEFT point is smaller than the MAX angle, reject the upper subtree.
 $\forall (x_l, y_l) : 270 < LA0 < \beta < 360 \text{ reject } \{(x, y) : x \geq x_l; y \geq y_l\}$
- If the angle to the RIGHT point is smaller than the MIN angle, reject the lower subtree.
 $\forall (x_r, y_r) : 270 < LA0 < \alpha < 360 \text{ reject } \{(x, y) : x \leq x_r; y \leq y_r\}$
- If the angle to the UPPER point is smaller than the MIN angle, reject the left subtree.
 $\forall (x_u, y_u) : 270 < LA0 < \alpha < 360 \text{ reject } \{(x, y) : x \leq x_u; y \leq y_u\}$
- If the angle to the BOTTOM point is greater than the MAX angle, reject the right subtree.
 $\forall (x_b, y_b) : 270 > \beta > LA0 > 360 \text{ reject } \{(x, y) : x \geq x_b; y \geq y_b\}$

5. Rules for 0 - 180 degree

- If the angle to the LEFT point is smaller than the MIN angle, reject the lower subtree.
 $\forall (x_l, y_l) : 0 < LA0 < \alpha < 180 \text{ reject } \{(x, y) : x \geq x_l; y \leq y_l\}$
- If the angle to the RIGHT point is greater than the MAX angle, reject the lower subtree.
 $\forall (x_r, y_r) : 0 < \beta < LA0 < 180 \text{ reject } \{(x, y) : x \leq x_r; y \leq y_r\}$

- 42 • If the angle to the UPPER point is greater than the MAX angle, reject the left subtree.
 43 $\forall (xu,yu) : 0 < \beta < LA0 < 180$ reject $\{ (x,y) : x \leq xu; y \leq yu \}$
 44 • If the angle to the UPPER point is smaller than the MIN angle, reject the right subtree.
 45 $\forall (xu,yu) : 0 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \geq xu; y \leq yu \}$

46 6. Rules for 90 - 270 degree

- 47 • If the angle to the LEFT point is greater than the MAX angle, reject the lower subtree.
 48 $\forall (xl,yl) : 90 > \beta > LA0 > 270$ reject $\{ (x,y) : x \geq xl; y \leq yl \}$
 49 • If the angle to the UPPER point is greater than the MAX angle, reject the right subtree.
 50 $\forall (xu,yu) : 90 > \beta > LA0 > 270$ reject $\{ (x,y) : x \geq xu; y \leq yu \}$
 51 • If the angle to the BOTTOM point is smaller than the MIN angle, reject the right subtree.
 52 $\forall (xb,yb) : 90 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \geq xb; y \geq yb \}$
 53 • If the angle to the LEFT point is smaller than the MIN angle, reject the upper subtree.
 54 $\forall (xl,yl) : 90 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \geq xl; y \geq yl \}$

55 7. Rules for 180 - 360 degree

- 56 • If the angle to the RIGHT point is smaller than the MIN angle, reject the upper subtree.
 57 $\forall (xr,yr) : 180 < LA0 < \alpha < 360$ reject $\{ (x,y) : x \leq xr; y \geq yr \}$
 58 • If the angle to the LEFT point is greater than the MAX angle, reject the upper subtree.
 59 $\forall (xl,yl) : 180 > \beta > LA0 > 360$ reject $\{ (x,y) : x \geq xl; y \geq yl \}$
 60 • If the angle to the BOTTOM point is greater than the MAX angle, reject the right subtree.
 61 $\forall (xb,yb) : 180 > \beta > LA0 > 360$ reject $\{ (x,y) : x \geq xb; y \geq yb \}$
 62 • If the angle to the BOTTOM point is smaller than the MIN angle, reject the left subtree.
 63 $\forall (xb,yb) : 180 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \leq xb; y \geq yb \}$

64 8. Rules for 270 - 90 degree

- 65 • If the angle to the RIGHT point is greater than the MAX angle, reject the upper subtree.
 66 $\forall (xr,yr) : 90 > \beta > LA0 > 270$ reject $\{ (x,y) : x \leq xr; y \geq yr \}$
 67 • If the angle to the RIGHT point is smaller than the MIN angle, reject the lower subtree.
 68 $\forall (xr,yr) : 90 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \leq xr; y \leq yr \}$
 69 • If the angle to the UPPER point is smaller than the MIN angle, reject the left subtree.
 70 $\forall (xu,yu) : 90 < LA0 < \alpha < 270$ reject $\{ (x,y) : x \leq xu; y \leq yu \}$
 71 • If the angle to the BOTTOM point is greater than the MAX angle, reject the left subtree.
 72 $\forall (xb,yb) : 90 > \beta > LA0 > 270$ reject $\{ (x,y) : x \leq xb; y \geq yb \}$