

# Graphics & Visualization

## Principles and Algorithms

### Errata

*Last update: 2 June 2018*

Each erratum is marked with a number corresponding to the date it was reported, as follows:

- 1 – 25 Jan 2009
- 2 – 16 Feb 2009
- 3 – 13 May 2009
- 4 – 11 Sep 2009
- 5 – 20 Jan 2010
- 6 – 20 Sep 2010
- 7 – 30 May 2011
- 8 – 24 June 2011
- 9 – 29 Apr 2013
- 10 – 16 Jun 2016
- 11 – 27 Dec 2016
- 12 – 2 Jun 2018

Errors are given in red, corrections in green.

- 1 **page xi.** Remove the last 2 lines of the page (they are repeated on the next page).
- 1 **page xiii.** In the bullet point referring to Chapter 17, change **page 622** to **page 620**.
- 5 **page 17.** In the paragraph on double buffering, second line, reverse **random/sequential** to **sequential/random** (so that they correspond to reading and writing of the frame buffer memory).
- 4 **page 17.** In the paragraph on double buffering, change the end of the first sentence from **generated.** to **generated, thus displaying an incomplete frame (this is called tearing).** (Suggestion by Sugih Jamin)
- 4 **page 18.** Change to second sentence of the page from **In this case ... differences.** to **Tearing is still possible if the sequential reading of the front buffer has not completed a whole frame and the contents of the two buffers have significant differences.** (Suggestion by Sugih Jamin)
- 5 **page 34.** In algorithm line3, the third line, **e=-(dx >> 1);**, must be moved after the lines assigning dx and dy.
- 1 **page 42.** In the first paragraph, line 8, change **rasterized** to **not rasterized**; conversely in line 9, change **not rasterized** to **rasterized**. Also correct the spelling of **verticies** (in lines 8–9) to **vertices**.
- 5 **page 43.** Lines 6–7: change **the minimum x** to **the x-coordinate of the intersection of the scanline with the edge**. Also in Figure 2.15, change the label  **$x_{\min}$**  to  **$x$** .
- 8 **page 99** In the second line from the bottom of the page, add the explanatory text (**since the angle  $\theta_2$  is negative**).

Moreover, in the next equation correct  $\sin \theta_2 = -\frac{a}{\sqrt{a^2+b^2+c^2}}$  (adding the negative sign).

Finally, in the matrix that follows, correct the signs corresponding to  $\sin \theta_2$ :

$$\mathbf{R}_y(\theta_2) = \begin{bmatrix} \frac{\sqrt{b^2+c^2}}{\sqrt{a^2+b^2+c^2}} & 0 & -\frac{a}{\sqrt{a^2+b^2+c^2}} & 0 \\ 0 & 1 & 0 & 0 \\ +\frac{a}{\sqrt{a^2+b^2+c^2}} & 0 & \frac{\sqrt{b^2+c^2}}{\sqrt{a^2+b^2+c^2}} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

- 5 **page 133.** In the last paragraph, first line, change  **$P_{PER}$**  to  **$P_{PER}$** . (Reported by Sugih Jamin)

- 1 **page 153.** In the caption of Figure 5.5, replace **stab** by **stub**.
- 1 **page 154.** Three lines before the end of the text, replace **stab** by **stub**.
- 4 **page 189.** Second paragraph, lines 2–3: rephrase **it is easily reversible to the coarse base model by performing *vertex splits* (Figure 6.9)** to **it is easily reversible by performing *vertex splits* (Figure 6.9) to the coarse base model**.
- 11 **page 194.** In the second line of paragraph 7.2.3, replace **inefficient** by **unstable**.
- 2 **page 212.** At the end of equation (7.32b) replace the index  $i$  by  $j$  so that the last line reads  $j = i - k + r, \dots$
- 5 **page 243.** Three lines after equation (7.66) change **curve** to **surface**.
- 5 **page 245.** Second paragraph, line 7: change **curve** to **surface**.
- 5 **page 247.** In exercise 4, at the start of the second line add the word **multiple** so that the sentence becomes **... to insert the same knot  $s$  multiple times...**
- 6 **page 251.** In the last line before section 8.3, replace  $(m_i \times n_j)$  with  $(m_i \cdot n_j)$ .
- 6 **page 251.** In the last line before section 8.3.1, replace **subscript** with **superscript**.
- 6 **page 252.** Last paragraph of the page, first line: replace **recursively** with **iteratively**.
- 6 **page 253.** In the caption of Figure 8.2, first line: correct **mask** to **masks**.
- 6 **page 259.** Right below equation (8.7) change  $P^{i+1}$  to  $P^{j+1}$  for consistency.
- 6 **page 261.** In item 4. of the enumeration, change  $P^{i+1}$  to  $P^{j+1}$  and  $P^i$  to  $P^j$  (twice, in (a) and (b) below) for consistency.
- 3 **page 264.** In item (b) and in equation (8.12) change  $\mathbf{v}_{i+1}^j$  to  $\mathbf{v}_i^{j+1}$ . Also in equation (8.12) change, for clarity, the summation index from  $j$  to  $k$  so that it becomes  $\sum_{k=1}^n \mathbf{c}_k$ .
- 3 **page 265.** In equation (8.14) change  $\alpha$  to  $\alpha_n$  (four times).
- 3 **page 265.** In step 1 of the modified butterfly scheme, change  $\mathbf{v}_{i+1}^j$  to  $\mathbf{v}_i^{j+1}$ .
- 3 **page 266.** In equation (8.15) change  $\mathbf{v}e_{i+1}^j$  to  $\mathbf{v}e_i^{j+1}$ . Also change the index  $i$  to  $k$  inside the summation so that it becomes  $\sum_{k=1}^8 \alpha_k \mathbf{c}_k$ .
- 3 **page 266.** In equation (8.16) change the index  $i$  with  $k$  everywhere.
- 3 **page 266.** In the last line change the index  $i$  with  $k$  for the vertices  $\mathbf{c}_i$  of the ring, which become  $(\mathbf{c}_k)_{(0 \leq k \leq n-1)}$ .
- 3 **page 267.** Right below equation (8.17), change **valency** to **valence** (for consistency of terminology).
- 3 **page 267.** In equation (8.17) change  $\mathbf{v}e_{i+1}^j$  to  $\mathbf{v}e_i^{j+1}$ . Also change the index  $i$  to  $k$  inside the summation so that it becomes  $\sum_{k=0}^{n-1} \alpha_k \mathbf{c}_k$ .
- 3 **page 267.** Right below equation (8.17) change  $i$  to  $k$  so that  $\alpha_i$  becomes  $\alpha_k$ . Also correct the first formula to  $\alpha_k = \frac{1}{n} \left( \frac{1}{4} + \cos \frac{2\pi k}{n} + \frac{1}{2} \cos \frac{4\pi k}{n} \right)$ .
- 4 **page 268.** In equation (8.19) and above change the index  $i$  to  $r$  for consistency, so that  $\alpha_i$  becomes  $\alpha_r$  and (8.19) becomes  $\alpha_r = 2 \sum_{j=0}^{\bar{n}} 2^{-j} \cos \frac{2\pi r j}{n}$ .
- 4 **page 269.** In steps 2(a) and 2(b) of the  $\sqrt{3}$  scheme, change index  $i$  in the notation of the ring vertices to  $k$ , so that  $\mathbf{b}_i$  becomes  $\mathbf{b}_k$  in step (a) and in equation (8.20) (where the summation index should also be changed from  $i$  to  $k$ ).
- 1 **page 269.** In Item 1 near the bottom of the page change “It is an interpolating scheme.” to “It is not an interpolating scheme.”

- 4 **page 270.** In the second paragraph of Section 8.5, two lines before the end, change **whereas the butterfly and  $\sqrt{3}$  schemes are interpolating** to **whereas the butterfly scheme is an interpolating one.**
- 6 **page 274.** In lines 4 and 5 from the top (not counting the equations) replace  $m \times n$  with  $m \cdot n$  (twice).
- 6 **page 276.** At the end of line 2, add a closing parenthesis after **( $\mathbf{c}_i$ ):** to get **( $\mathbf{c}_i$ ):**.
- 6 **page 279.** Second paragraph, four lines before the end, replace  $\varphi^i$  with  $\varphi_i$ .
- 6 **page 280.** In third line of the last paragraph before Section 8.6.2, and in the equation beneath, replace  $\hat{\mathbf{A}}^k$  with  $\hat{\mathbf{A}}_k$  (twice).
- 6 **page 281–282.** Change the last **,** of page 281 to **.** and delete the first sentence of page 282 (**where ... eigenvalue**).
- 6 **page 292.** In the paragraph before equation (8.33), rephrase **... from the constrained minimization problem. Minimize  $\Pi_a$  subject to  $\mathbf{C}_a \mathbf{u}_x = \mathbf{g}_a$ , whose solution is obtained as with ... from the constrained minimization problem: minimize  $\Pi_a$  subject to  $\mathbf{C}_a \mathbf{u}_x = \mathbf{g}_a$ .** Its solution is obtained as.
- 5 **page 372.** In Figure 12.5, the angles  $\phi_r$  and  $\phi_i$  should be marked as  $\varphi_r$  and  $\varphi_i$  for consistency with the text. (Reported by Sugih Jamin)
- 5 **page 379.** In Figure 12.11, the angle  $\phi$  should be marked as  $\varphi$  for consistency with the text. (Reported by Sugih Jamin)
- 12 **page 384.** In the third paragraph, correct **associative** to **commutative**.
- 9 **page 388.** In the 4th line, correct **outer** to **cross**.
- 5 **page 390.** Starting from the end of line 4 of 12.6, change the sentence **In 1971 Gouraud ... at the vertices [Gour71] to Warnock, Romney and Watkins suggested the interpolation of intensity values within polygons from intensity values computed at the vertices. In 1971 Gouraud [Gour71] integrated their works and suggested the computation of unique vertex normals on shared polygon vertices..**
- 1 **page 467.** Last line before the final paragraph: correct spelling of **repspectively** to **respectively**.
- 1 **page 469.** In equation (14.6) change  $p_2$  to  $\mathbf{p}_2$  on the first line and  $p_3$  to  $\mathbf{p}_3$  on the second line (that is, change italics to bold so that they are marked as points).
- 7 **page 497.** In the 10th line of Section 14.5.1, replace **pseudo-number** with **pseudo-random number**. (Reported by Sugih Jamin)
- 7 **page 545.** In the 8th line of the code at the top of the page replace **prim->isect(r)** with **prim->isect(shadowRay)**. (Reported by Sugih Jamin)
- 9 **page 554.** In the last line, correct **q** to **q'**.
- 7 **page 599.** Replace the last sentence of the second paragraph, **Bidirectional ray tracing was developed ... and Veach [Veac94].** with **Bidirectional ray-tracing was proposed by Arvo [Arvo86] and then developed, among others, by Heckbert [Heck90], Lafortune and Willems [Laf94], and Veach and Guibas [Veac94].** See below for the two new references [Arvo86] and [Heck90]. (Reported by Sugih Jamin)
- 10 **page 660.** The commands of the inner loop in the algorithm at the top of the page become:

```

frame_buffer(x+a,y+b)=
    frame_buffer(x+a,y+b)+
    voxel(x,y,s)*footprint(a,b)*
    (1-transparency_buffer(x+a,y+b))
transparency_buffer(x+a,y+b)=
    min(1,transparency_buffer(x+a,y+b)+
    transp(voxel(x,y,s))
    *footprint(a,b))

```

- 4 **page 668.** Change the last part of the first line and the start of the second line from ; they are also to and.
- 1 **page 676.** In the middle of the page, change  $\lambda[a_x, a_y, a_z]$  to  $\lambda[a_x, a_y, a_z]^T$  (add the transpose mark).
- 1 **page 678.** In the fifth line of text, change vector  $[5, 1, ?2]$  to  $[5, 1, ?2]^T$  (add the transpose mark).
- 7 **page 717.** Add the following reference: [Arvo86] James Arvo, “Backward Ray Tracing”, *Developments in Ray Tracing, SIGGRAPH '86 Course Notes*, 1986.
- 7 **page 725.** Add the following reference: [Heck90] Paul S. Heckbert, “Adaptive Radiosity Textures for Bidirectional Ray Tracing”, In *Proceedings of SIGGRAPH '90*, pp. 145–154, 1990.