Essential Mathematics for Games and Interactive Applications, 2nd Edition — Errata

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Issue 1

Page 5, first paragraph.

> the mantissa be "normalized" (i.e., have magnitude in the range [1.0, 10.0]).

Fix

A *normalized* mantissa can be upto but not including 10.0.

> the mantissa be "normalized" (i.e., have magnitude in the range [1.0, 10.0**)**).

— Sundaram Ramaswamy

Issue 2

Page 51, figure 2.13, length of the projection.

> $\|\mathbf{v}\| \cos(\theta) / \|\mathbf{w}\|$

Fix

> $\mathbf{v} \cdot \mathbf{w} / \|\mathbf{w}\| = \|\mathbf{v}\|\|\mathbf{w}\| \cos(\theta) / \|\mathbf{w}\| = \|\mathbf{v}\| \cos(\theta)$

— Sundaram Ramaswamy

Issue 3

Page 117, second paragraph.

> There is a single solution only if the rank of $\mathbf{A}$ is equal to the minimum of the number of rows or columns of $\mathbf{A}$.

Fix

There is a single solution only if the rank of the coefficient matrix equals the number of unknowns in the equation i.e. there should be no free variables, which is given by unknowns $-$ rank; otherwise the system becomes underdetermined or overdetermined. If the above statement were true, a system with 3 unknowns and a 2×3 coefficient matrix of rank 2 would've a single solution while such an underdetermined system would have no or infinite solutions due to that one free variable.

— Jacob Shields

Issue 4

Page 126, second paragraph under §3.6.3

> The first part of the determinant sum is $u_{0,0}\tilde{\mathbf{U}}_{0,0}$. [...]
>
> $$det(\mathbf{U}) = u_{0,0}\tilde{\mathbf{U}}_{0,0}$$

Fix

The determinant of a real matrix is a (real) scalar, not another matrix. In both cases it should be

$$det(\mathbf{U}) = u_{0,0}\, det(\tilde{\mathbf{U}}_{0,0})$$

— Jacob Shields

Issue 5

Page 130, second paragraph.

> It turns out that the columns of $\mathbf{R}$ are the eigenvectors of $\mathbf{A}$, and the diagonal elements of $\mathbf{D}$ are the corresponding eigen*vectors*.

Fix

> It turns out that the columns of $\mathbf{R}$ are the eigenvectors of $\mathbf{A}$, and the diagonal elements of $\mathbf{D}$ are the corresponding eigen*values*.

— Jacob Shields

Issue 6

Page 178, §5.3.3 Concatenation

> Applying $(\pi/2, \pi/2, \pi/2)$ twice doesn't end up at the same orientation as (π, π, π).

Fix

> Applying $(\pi/4, \pi/4, \pi/4)$ twice doesn't end up at the same orientation as $(\pi/2, \pi/2, \pi/2)$.

— Jacob Shields

Issue 7

Page 181, last sentence.

> Near-parallel vectors may cause us some problems either because the dot product is near 0, or normalizing the cross product ends up dividing by a near-zero value.

Fix

> Near-parallel vectors may cause us some problems either because the cross product results in a $\mathbf{0}$ vector, or normalizing the cross product may lead to division by a near-zero value. The dot product should be near 1, but through floating point error, may result in a magnitude slightly greater than 1, which is not valid input to `acos`.

— Jacob Shields

Issue 8

Page 191, equation 5.7.

$$\hat{\mathbf{q}} = (2\cos\theta + 2, 2\sin\theta\,\hat{\mathbf{r}})$$

Fix

$$\mathbf{q} = (2\cos\theta + 2, 2\sin\theta\,\hat{\mathbf{r}})$$

— Jacob Shields

Issue 9

Page 191, below the third equation.

> we just need to compute $(\mathbf{w}_1 + \mathbf{w}_2)/2$

Fix

> we just need to compute $(\mathbf{w}_0 + \mathbf{w}_1)/2$

— Jacob Shields

Issue 10

Page 198, second equation.

$$R_{\mathbf{q}}(\mathbf{p}) = \left(2\cos^2\left(\frac{\theta}{2}\right) - 1\right)\mathbf{p} + \left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right)\cdot\mathbf{p}\right)\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right) + 2\cos\left(\frac{\theta}{2}\right)\left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right)\times\mathbf{p}\right)$$

Fix

$$R_{\mathbf{q}}(\mathbf{p}) = \left(2\cos^2\left(\frac{\theta}{2}\right) - 1\right)\mathbf{p} + \mathbf{2}\left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right)\cdot\mathbf{p}\right)\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right) + 2\cos\left(\frac{\theta}{2}\right)\left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right)\times\mathbf{p}\right)$$

— Salih

Issue 11

Page 250, equation of x_v and the first equation in the following page.

$$x_v = \frac{2a}{w_s}(x_s - s_x) - 1$$

$$\begin{bmatrix} x_v \\ y_v \\ z_v \end{bmatrix} = \begin{bmatrix} \frac{2a}{w_s} & 0 & -\frac{2a}{w_s}s_x - 1 \\ 0 & -\frac{2}{h_s} & \frac{2}{h_s}s_y + 1 \\ 0 & 0 & -d \end{bmatrix} \begin{bmatrix} x_s \\ y_s \\ 1 \end{bmatrix}$$

Fix

The whole thing should be multiplied by the aspect ratio, which results in

$$x_v = \frac{2a}{w_s}(x_s - s_x) - a$$

$$\begin{bmatrix} x_v \\ y_v \\ z_v \end{bmatrix} = \begin{bmatrix} \frac{2a}{w_s} & 0 & -\frac{2a}{w_s}s_x - a \\ 0 & -\frac{2}{h_s} & \frac{2}{h_s}s_y + 1 \\ 0 & 0 & -d \end{bmatrix} \begin{bmatrix} x_s \\ y_s \\ 1 \end{bmatrix}$$

— Aapo Laitinen

Issue 12

Page 636, second paragraph.

> Each object will have its own value of epsilon. [...]

Following page, equation 13.18 contains a term ϵ_a, and below it is written

> The equation for j_b is similar, except that we substitute *epsilon*$_b$ for *epsilon*$_a$.

The code on page 638 follows this by referring to `m_Elasticity` and `other->m_Elasticity`.

Fix

These assertions are incorrect. The coefficient of restitution is not a property of an individual object — it is a property of the collision itself. This can be seen clearly in equation 13.15, which applies to both objects. So if we are considering four materials A, B, C, and D, there would be six possible coefficients of restitution: A colliding with B, A colliding with C, A colliding with D, B colliding with C, B colliding with D, and C colliding with D.

— James McGovern

Issue 13

Page 639, the moments of inertia tensors used in the collision response equations are referred to as I_a and I_b.

Fix

These should be J_a and J_b to match the previous notation used. The intent of this was to separate the notation for the identity matrix from the notation for the inertia tensor. However, standard convention is to use I for the inertia tensor, hence the typo.

— Johnny Newman