Visual Explanation of Proposed Fix for Spurious TIR Illustrated using a representative example

Peter Kutz | April 24, 2024

incoming light



air with IOR 1.0

smooth interface

coat with IOR 2.0

smooth interface



The setup

air with IOR 1.0

relative IOR 2.0/1.0

coat with IOR 2.0

relative IOR 1.5/2.0



What happens in reality

air with IOR 1.0

coat with IOR 2.0

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What happens in reality

air with IOR 1.0

coat with IOR 2.0 R = 0.3 (always <= 0.5 when base IOR < coat IOR) TIR never occurs

What happens if coat refraction is ignored

air with IOR 1.0

coat with IOR 2.0

What happens if coat refraction is ignored

air with IOR 1.0

coat with IOR 2.0

relative IOR for reflection 1.5/2.0 relative IOR for refraction 1.5/1.0

What happens if coat refraction is ignored

air with IOR 1.0

coat with IOR 2.0

TIR occurs; artifacts appear

same final refraction angle

R = 1.0

Simply physically based solution: inverting the relative IOR

air with IOR 1.0

coat with IOR 2.0

relative IOR for reflection **2.0/1.5** (inverted) relative IOR for refraction **1.5/1.0**

Simply physically based solution: inverting the relative IOR

air with IOR 1.0

coat with IOR 2.0 0.3 < R < 1.0 TIR never occurs; artifacts gone

Intuition about why it works (reality setup)

air with IOR 1.0

coat with IOR 2.0

air with IOR 1.0

coat with IOR 2.0 R = 0.3 (with relative IOR 1.5/2.0)

R = 0.3 (with relative IOR 2.0/1.5) base with IOR 1.5

Intuition about why it works (ignoring coat refraction)

air with IOR 1.0

coat with IOR 2.0

1.0 > R > 0.3 (with relative IOR 2.0/1.5)

R = 0.3 (with relative IOR 2.0/1.5)

This solution produces a base reflection that is slightly higher than reality.

For a more accurate solution, the relative IOR would need to be modified differently (instead of simply being inverted).

At a high level, the relative IOR would need to be reduced (toward 1.0) to eliminate the extra reflectivity.

TODO:

