USING HELMHOLTZ RECIPROCITY IN VARIABLE RESOLUTION BSDFS IN RADIANCE

TL+FFF – PROJECT NUMBER 1637

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I INTRODUCTION

This document complements the report “Validation of Variable Resolution BSDFs in RADIANCE”.

In the new version of *rttree_reduce* Helmholtz reciprocity of BSDFs can be used for averaging corresponding directions and thus smoothing the distribution by setting the option “*-a*”. In this document the effects of this option shall be evaluated.

Variable-resolution BSDFs are generated with *genBSDF* for the RADIANCE native materials *plastic* and *trans* (isotropic) as well as *plastic2* and *trans2* (anisotropic), and the maximum resolution (1024 x 1024 patches or 4096 x 4096 patches) is varied.
The resulting data is reduced with *rttree_reduce* using the new option “*-a*” at various degrees (0%, i.e. no reduction, 95%, i.e. reduction by approximately 95%, and 99%, i.e. only about 1% of data left).

For each evaluated material/genBSDF-setting combination 3 images were rendered representing the three degrees of reduction with *rttree_reduce*.

The renderings were produced with the following *rpict* command:
rpict -x 1600 -y 1600 -ab 1 -ad 2048 -as 500 -aa .05 -vf fish.vf -lw 1e-5 -ss 64 -ps 16 -pt .05 -st .02 –dt 0 -af xxx.amb
Setting the direct threshold (-dt) to zero is crucial to allow direct contributions from every single ray and not to neglect contributions due to a high number of spawn specular rays.

The images are arranged as shown in the following table:

• Degree of reduction in rttree_reduce: 0% • Original implementation of *rttree_reduce* (without “-a”)	• Degree of reduction in rttree_reduce: 0% • New implementation of *rttree_reduce* (with "-a")
• Degree of reduction in rttree_reduce: 95% • Original implementation of *rttree_reduce* (without "-a")	• Degree of reduction in rttree_reduce: 95% • New implementation of *rttree_reduce* (with "-a")
• Degree of reduction in rttree_reduce: 99% • Original implementation of *rttree_reduce* (without "-a")	• Degree of reduction in rttree_reduce: 99% • New implementation of *rttree_reduce* (with "-a")

II ISOTROPIC

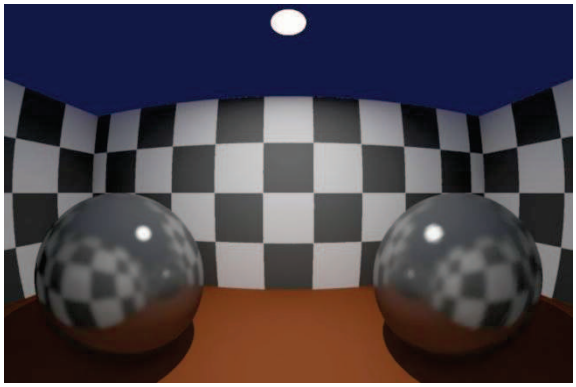
II.1 MATERIAL *PLASTIC*

Material:

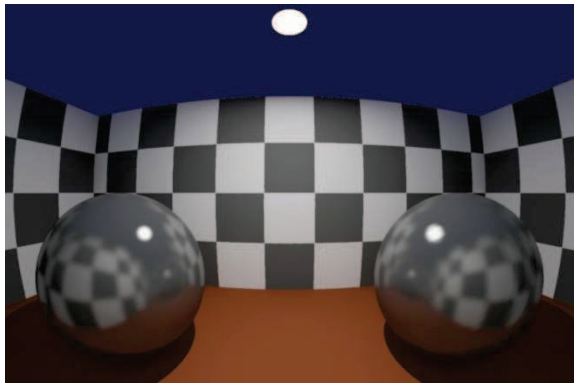
void plastic ptest_20_05 0 0 5 .1 .1 .1 .2 .05

genBSDF-Call:

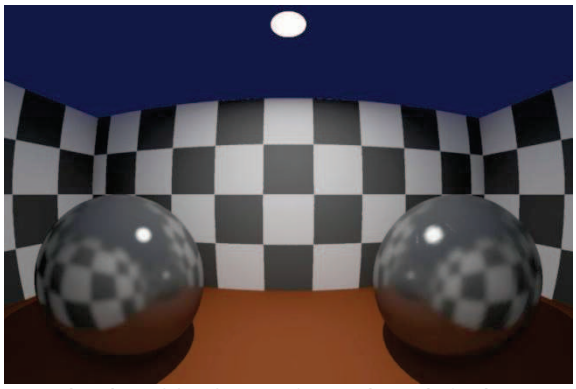
genBSDF -n 8 -t3 5 -c 10240 +b -mgf -geom meter -r -ss 16 -f



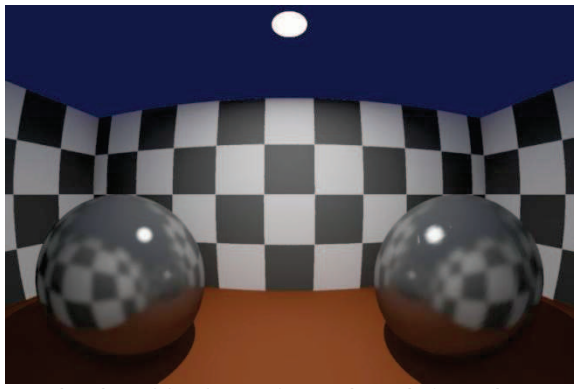
plastic_s20_r05_ss64_reduced_0.jpg



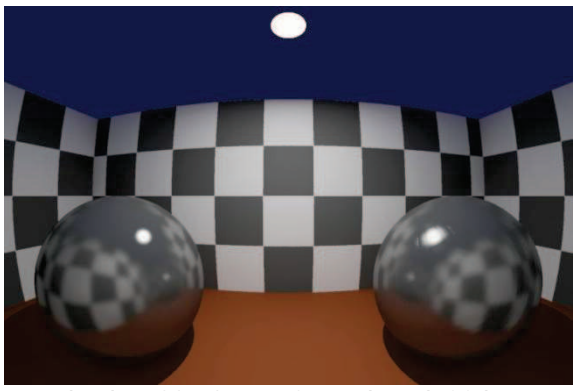
plastic_s20_r05_ss64_reduced_0_a.jpg



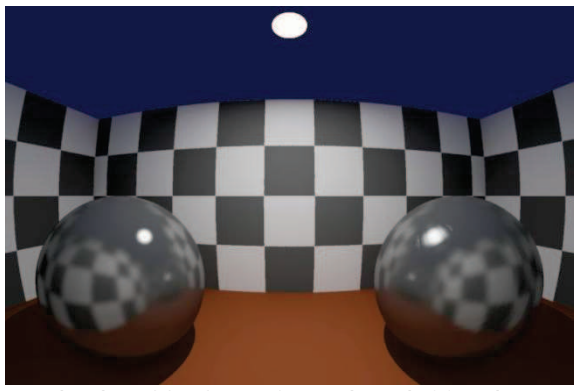
plastic_s20_r05_ ss64_reduced_95.jpg



plastic_s20_r05_ss64_reduced_95_a.jpg



plastic_s20_r05_ ss64_reduced_99.jpg



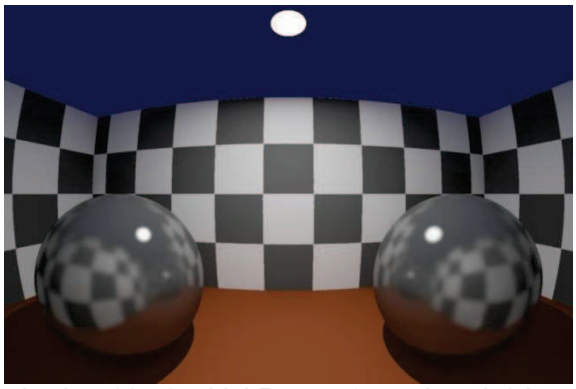
plastic_s20_r05_ss64_reduced_99_a.jpg

Material:

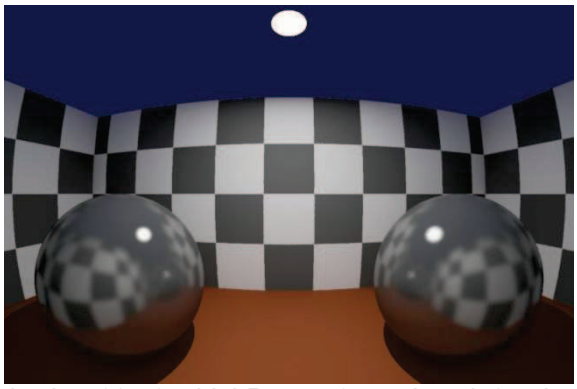
void plastic ptest_20_05 0 0 5 .1 .1 .1 .2 .05

genBSDF-Call:

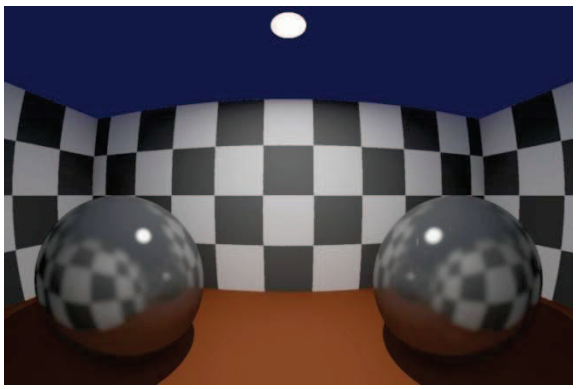
genBSDF -n 8 -t3 6 -c 40960 +b -mgf -geom meter -r -ss 16 -f



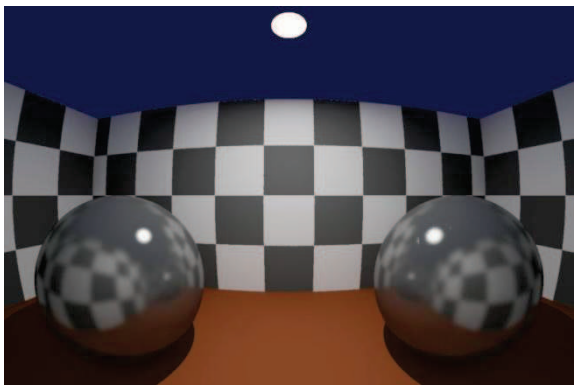
plastic_s20_r05_highRes_ss64_reduced_0.jpg



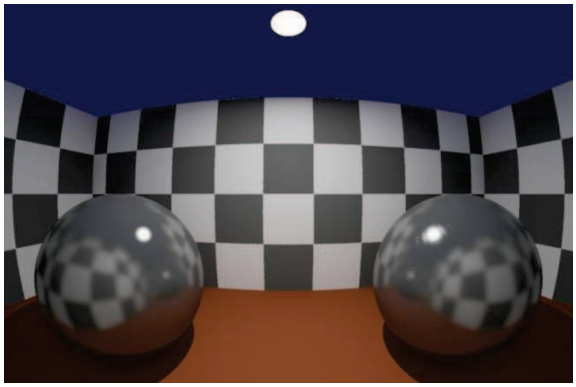
plastic_s20_r05_highRes_ss64_reduced_0_a.jpg



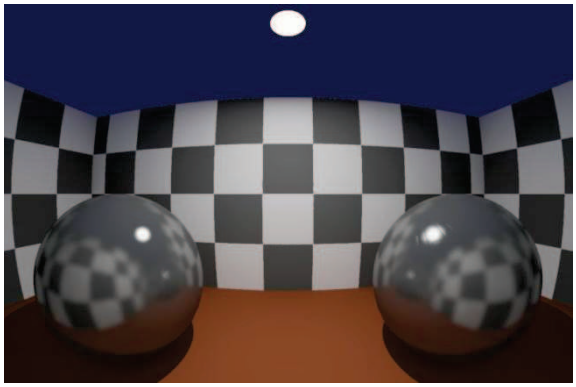
plastic_s20_r05_highRes_ss64_reduced_95.jpg



plastic_s20_r05_highRes_ss64_reduced_95_a.jpg



plastic_s20_r05_highRes_ss64_reduced_99.jpg



plastic_s20_r05_highRes_ss64_reduced_99_a.jpg

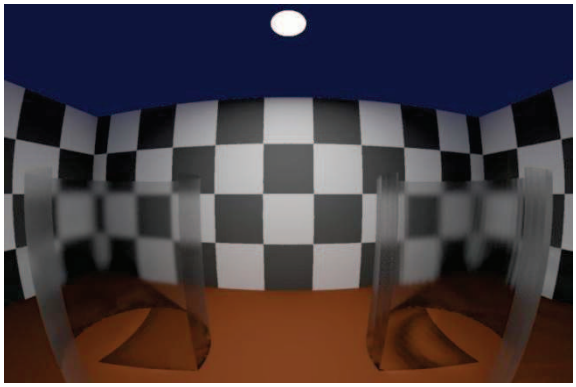
II.2 MATERIAL *TRANS*

Material:

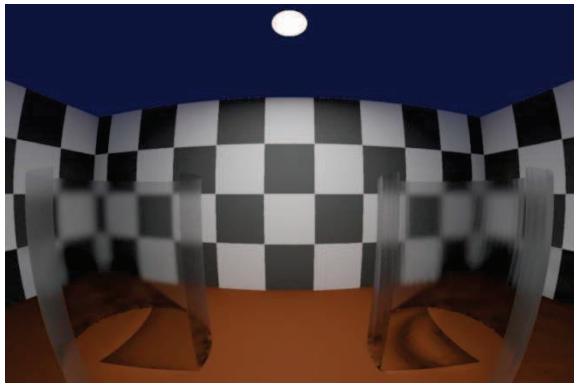
void trans ttest_80_05 0 0 7 .8 .8 .8 .0 .05 1.0 .8

genBSDF-Call:

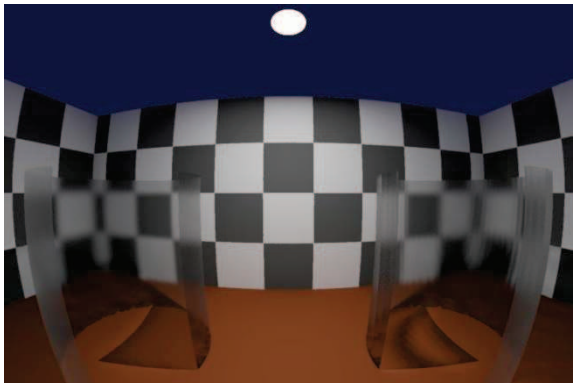
genBSDF -n 8 -t3 5 -c 10240 +b -mgf -geom meter -r -ss 16 +f



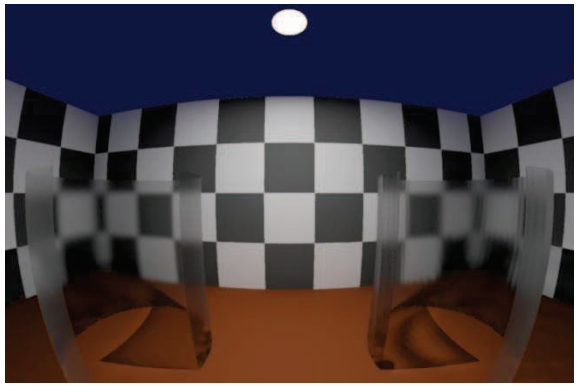
trans_ts80_r05_ss64_reduced_0.jpg



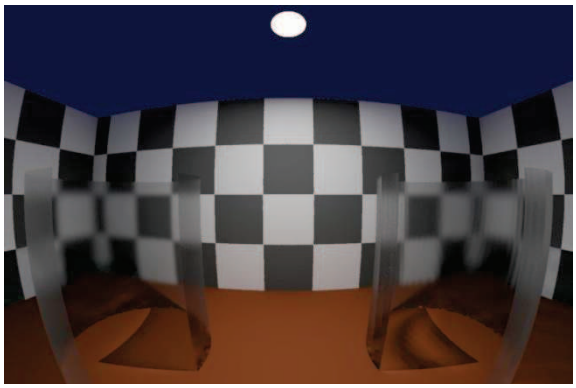
trans_ts80_r05_ss64_reduced_0_a.jpg



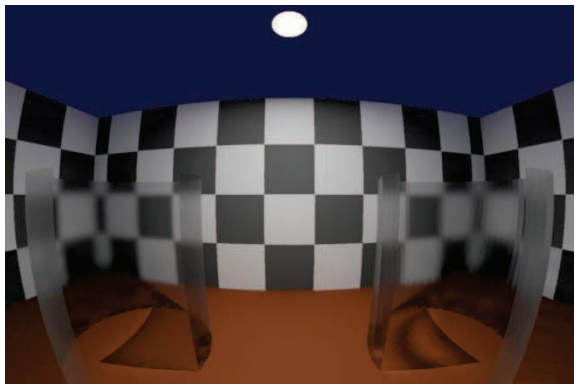
trans_ts80_r05_ ss64_reduced_95.jpg



trans_ts80_r05_ss64_reduced_95_a.jpg



trans_ts80_r05_ ss64_reduced_99.jpg



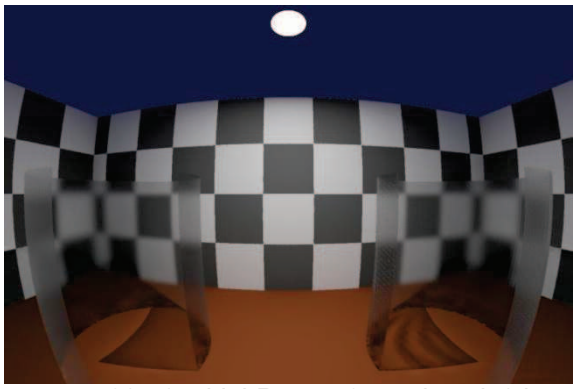
trans_ts80_r05_ss64_reduced_99_a.jpg

Material:

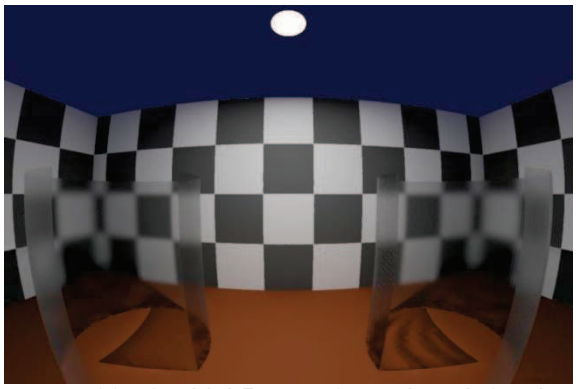
void trans ttest_80_05 0 0 7 .8 .8 .8 .0 .05 1.0 .8

genBSDF-Call:

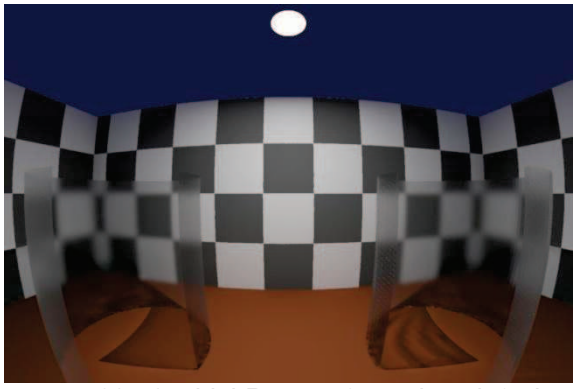
genBSDF -n 8 -t3 6 -c 40960 +b -mgf -geom meter -r -ss 16 +f



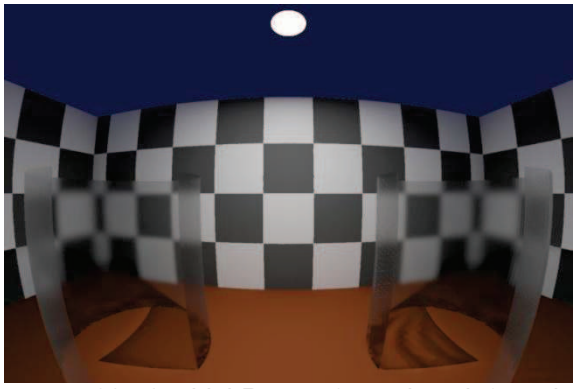
trans_ts80_r05_highRes_ss64_reduced_0.jpg



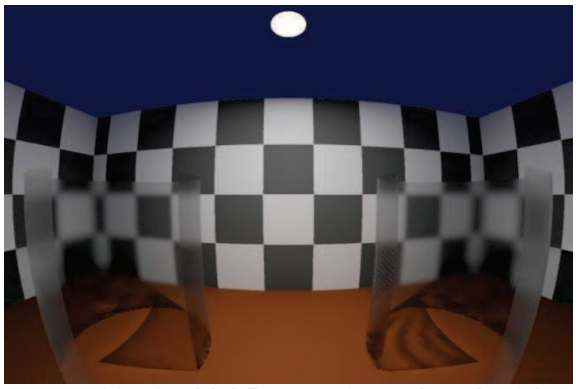
trans_ts80_r05_highRes_ss64_reduced_0_a.jpg



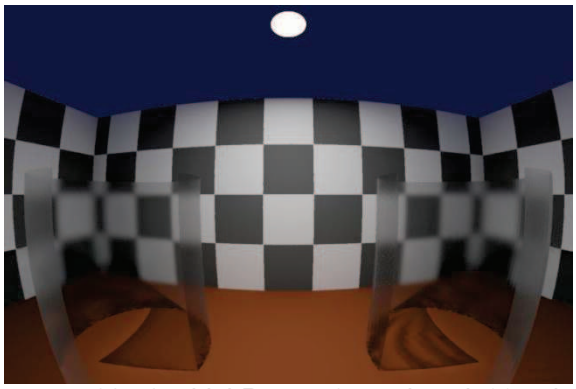
trans_ts80_r05_highRes_ ss64_reduced_95.jpg



trans_ts80_r05_highRes_ss64_reduced_95_a.jpg



trans_ts80_r05_highRes_ ss64_reduced_99.jpg



trans_ts80_r05_highRes_ss64_reduced_99_a.jpg

III ANISOTROPIC

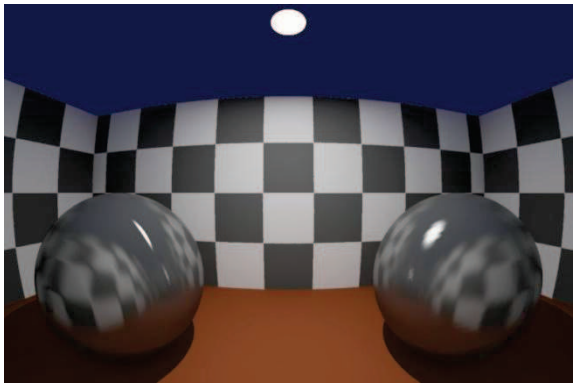
III.1 MATERIAL *PLASTIC2*

Material:

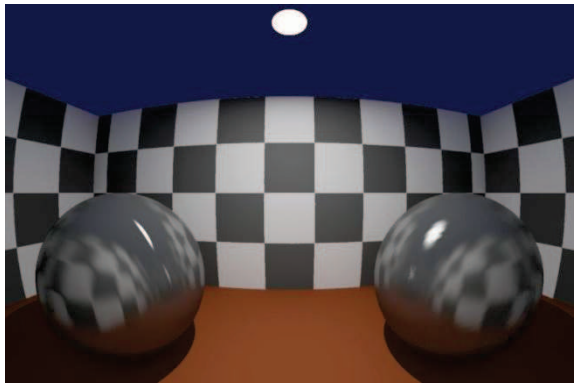
void plastic2 ptest2_20_01_10 4 0 1 0 . 0 6 .1 .1 .1 .2 .01 .10

genBSDF-Call:

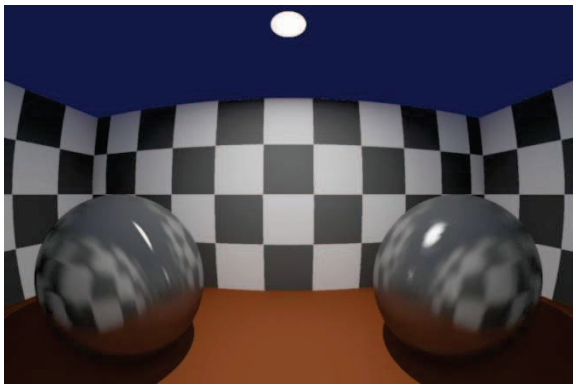
genBSDF -n 8 -t4 5 -c 10240 +b -mgf -geom meter -r -ss 16 -f



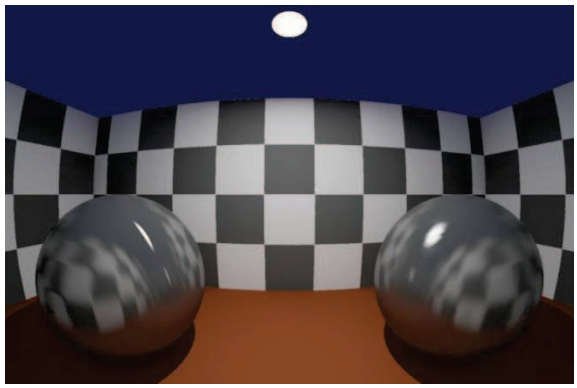
plastic2_s20_r01r10_ss64_reduced_0.jpg



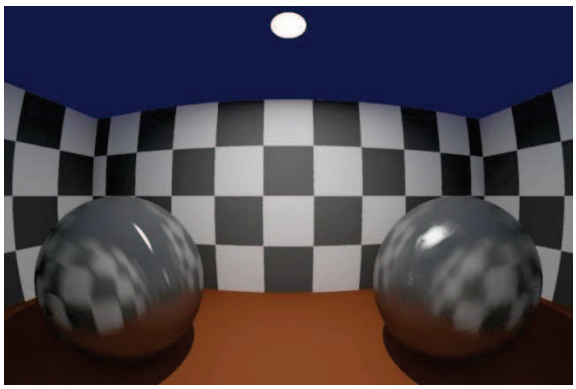
plastic2_s20_r01r10_ss64_reduced_0_a.jpg



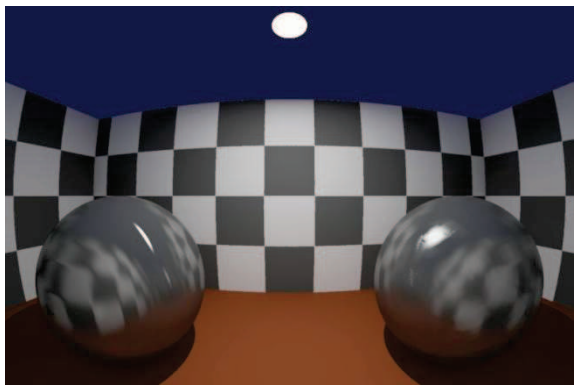
plastic2_s20_r01r10_ ss64_reduced_95.jpg



plastic2_s20_r01r10_ss64_reduced_95_a.jpg



plastic2_s20_r01r10_ ss64_reduced_99.jpg



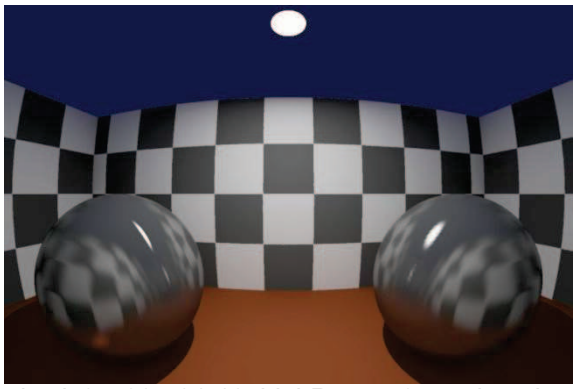
plastic2_s20_r01r10_ss64_reduced_99_a.jpg

Material:

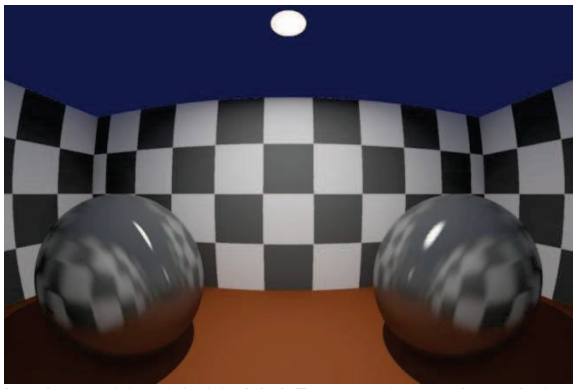
void plastic2 ptest2_20_01_10 4 0 1 0 . 0 6 .1 .1 .1 .2 .01 .10

genBSDF-Call:

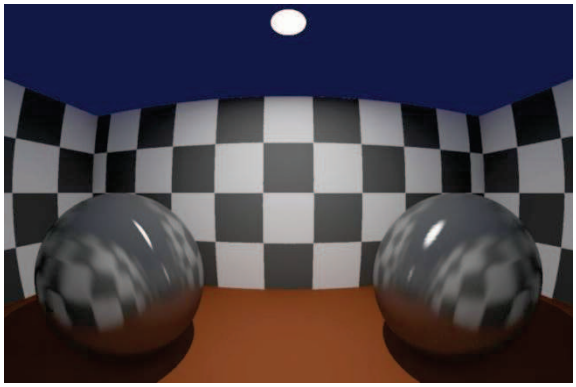
genBSDF -n 8 -t4 6 -c 40960 +b -mgf -geom meter -r -ss 16 -f



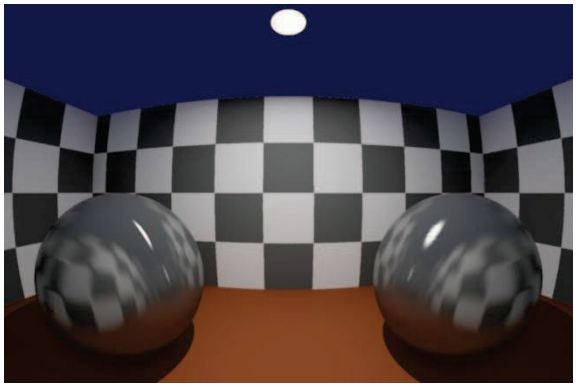
plastic2_s20_r01r10_highRes_ss64_reduced_0.jpg



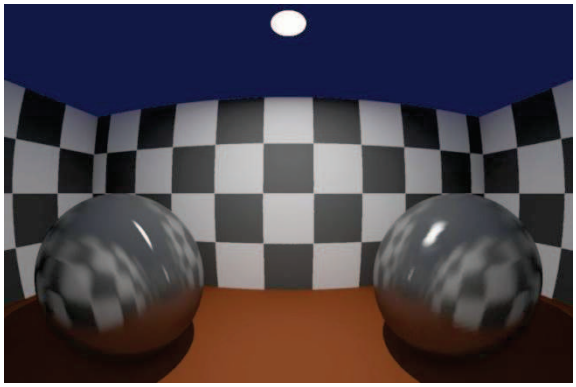
plastic2_s20_r01r10_highRes_ss64_reduced_0_a.jpg



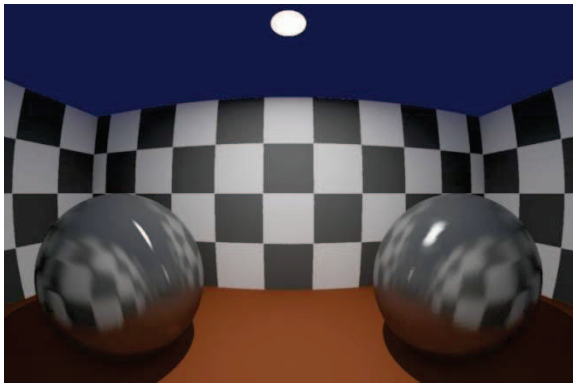
plastic2_s20_r01r10_highRes_ss64_reduced_95.jpg



plastic2_s20_r01r10_highRes_ss64_reduced_95_a.jpg



plastic2_s20_r01r10_highRes_ss64_reduced_99.jpg



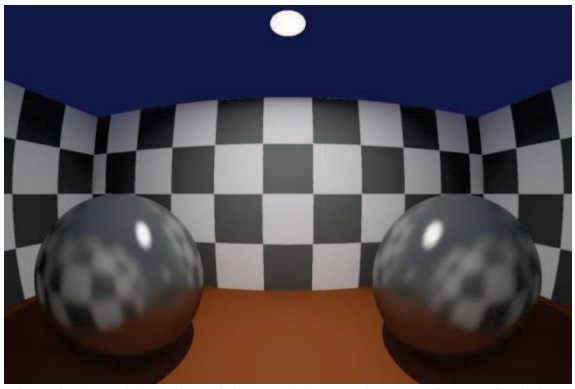
plastic2_s20_r01r10_highRes_ss64_reduced_99_a.jpg

Material:

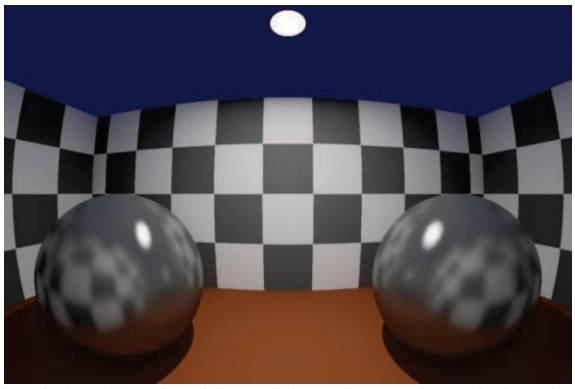
void plastic2 ptest2_20_05_10_rot30 4 0.57735 1 0 . 0 6 .1 .1 .1 .2 .05 .10

genBSDF-Call:

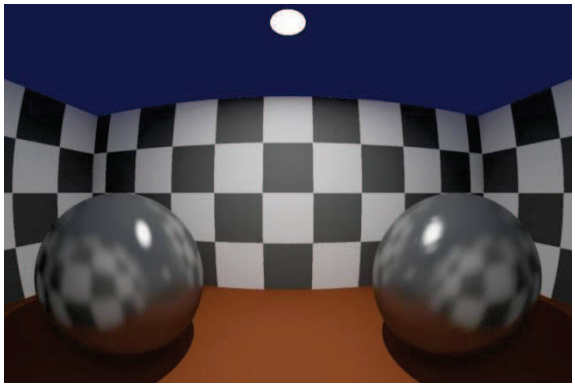
genBSDF -n 8 -t4 5 -c 10240 +b -mgf -geom meter -r -ss 16 -f



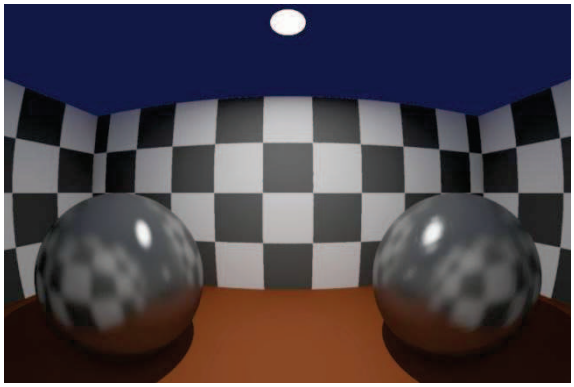
plastic2_s20_r05r10_rot30_ss64_reduced_0.jpg



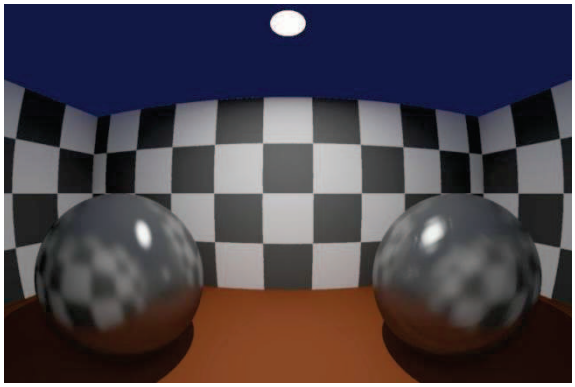
plastic2_s20_r05r10_rot30_ss64_reduced_0_a.jpg



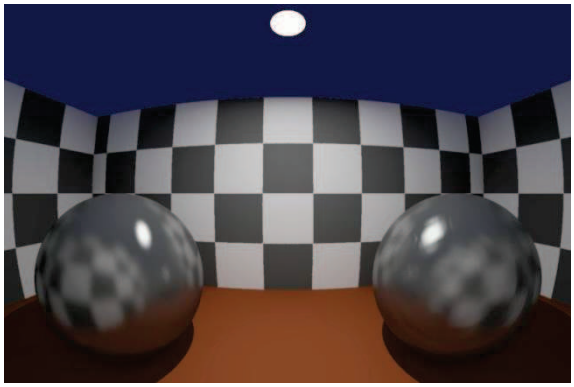
plastic2_s20_r05r10_rot30_ss64_reduced_95.jpg



plastic2_s20_r05r10_rot30_ss64_reduced_95_a.jpg



plastic2_s20_r05r10_rot30_ss64_reduced_99.jpg



plastic2_s20_r05r10_rot30_ss64_reduced_99_a.jpg

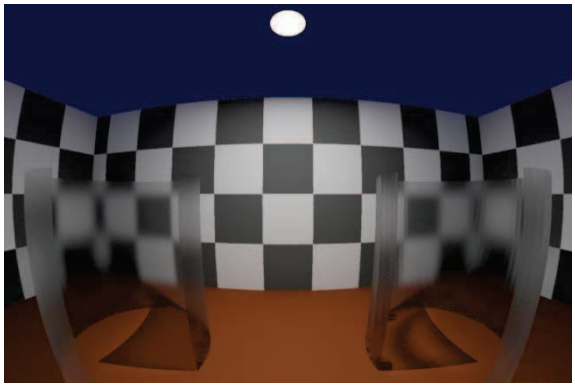
III.2 MATERIAL *TRANS2*

Material:

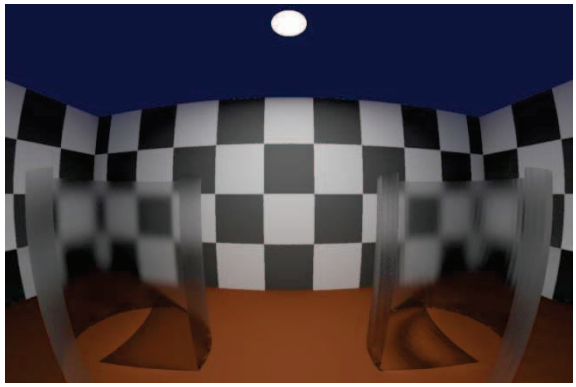
void trans2 ttest2_80_05_10 4 0 1 0 . 0 8 .8 .8 .8 .0 .05 .10 1.0 .8

genBSDF-Call:

genBSDF -n 8 -t4 5 -c 10240 +b -mgf -geom meter -r -ss 16 +f



trans2_ts80_r05r10_ss64_reduced_0.jpg



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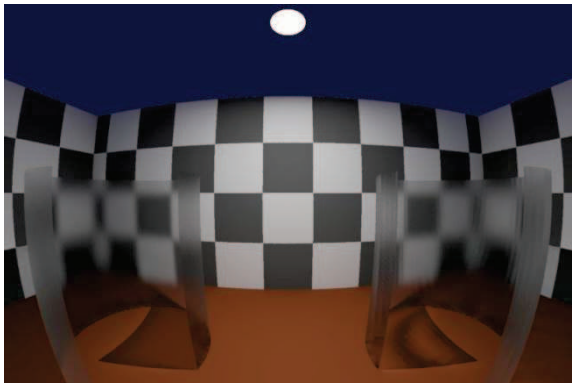

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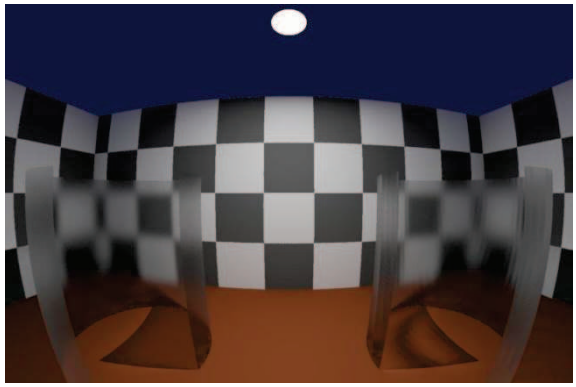

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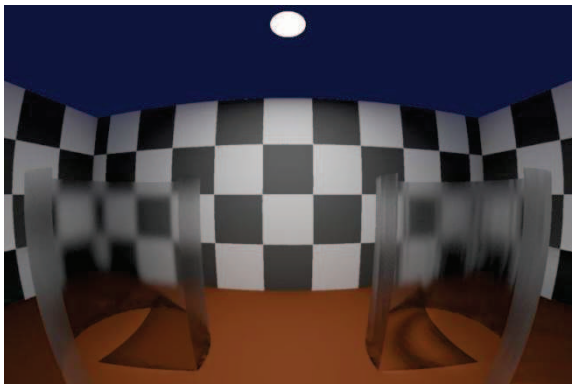

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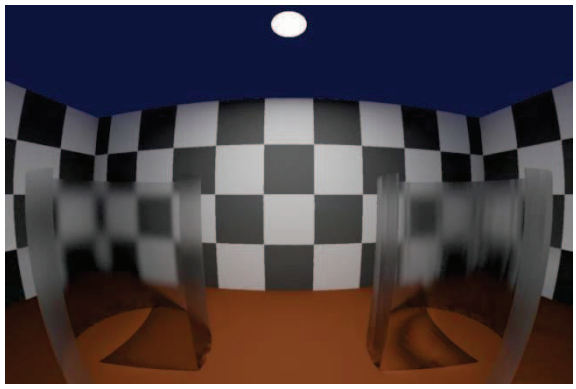


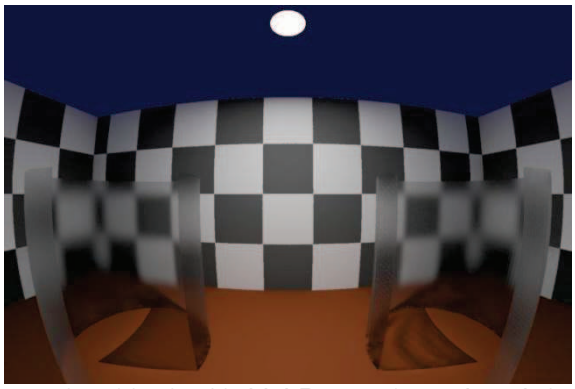
trans2_ts80_r05r10_ss64_reduced_99_a.jpg

Material:

void trans2 ttest2_80_05_10 4 0 1 0 . 0 8 .8 .8 .8 .0 .05 .10 1.0 .8

genBSDF-Call:

genBSDF -n 8 -t4 6 -c 40960 +b -mgf -geom meter -r -ss 16 +f



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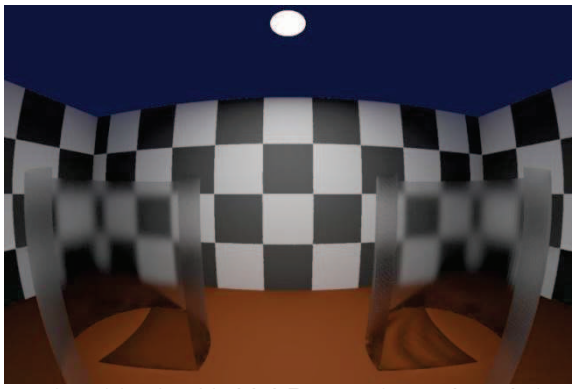

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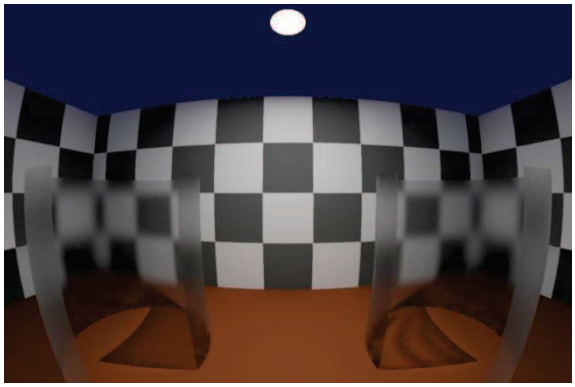

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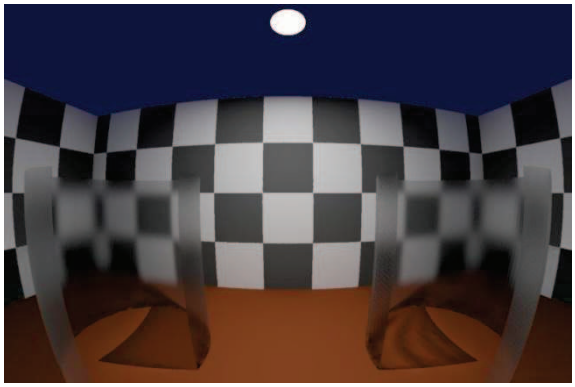

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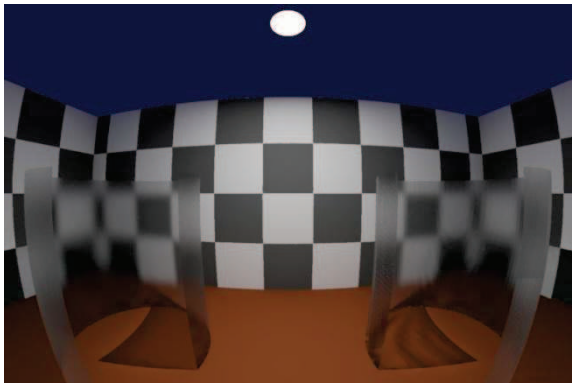
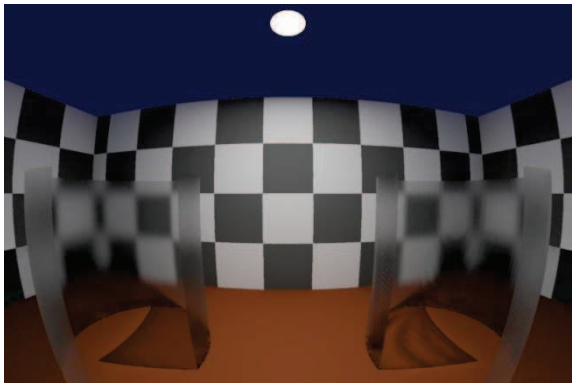


trans2_ts80_r05r10_highRes_ss64_reduced_99.jpg



trans2_ts80_r05r10_highRes_ss64_reduced_99_a.jpg

IV CONCLUSION

Between using Helmholtz reciprocity with "*-a*" in *rttree_reduce* and not using it, no differences that could be distinguished from Monte Carlo noise can be identified.

Thus,

- the implementation of the option "*-a*" in *rttree_reduce* seems to be correct and
- the parameter settings that were adopted from the validation procedure seem to be too high to observe differences between using "*-a*" and not doing so.

However, using reciprocity in the reduction process allows tracing less rays (in fact half of them) in the calculation of BSDFs (parameter "*-c*" in *genBSDF*) without losing accuracy.

21.11.2011 / 06.10.2014
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