Supplementary

The two subroutines, getRprobe() for the contact probe and getRdprobe() for the non-contact probe, are presented. First, the optical properties of absorption coefficient (m_a [cm^{-1}] labeled ma) and reduced scattering coefficient (m_s'[cm^{-1}] labeled msp) used in the Monte Carlo simulations are prepared as follows (MATLAB notation):

```
ma = [
   0.0010    0.0018    0.0034    0.0062    0.0113    0.0207...
   0.0379    0.0695    0.1274,   0.2336    0.4281    0.7848...
   1.4384    2.6367    4.8329    8.8587    16.2378   29.7635,...
   54.5559   100.0];
lma = log10(ma);
msp = [
   1.0000    1.3501    1.8228    2.4611    3.3228    4.4862...
   6.0569    8.1776    11.0407,  14.9064   20.1256   27.1721...
   36.6858   49.5305   66.8725   90.2863   121.8981  164.5780,...
   222.2012  300.0];
lmsp = log10(msp);
[LMSP LMA]   = meshgrid(log(msp),log(ma));
```

for use by the subroutines listed in the following subsections.

Contact probe getRprobe()

The subroutine getRprobe() returns the predicted probe response $R_{probe}(m_a,m_s')$ for a particular m_a,m_s' pair when the probe is in contact with a homogeneous tissue. The subroutine uses 2D interpolation (the function griddata.m in MATLAB):

```
function Rprobe = getRprobe(mua,musp,LMSP,LMA,gridRprobe)
lmua = log10(mua);
lmusp = log10(musp);
Rprobe = griddata(LMSP,LMA,Rprobe,lmusp,lmua);
```

which uses the following array gridRprobe(1:20,1:20) that holds the values for $R_{probe}(m_a,m_s')$ [W collected per W delivered] or [dimensionless]:

gridRprobe(1:20,1:10) $x10^5$ =

1.5119	2.1049	2.9215	4.1072	5.7454	8.0885	11.3420	15.7080	21.2349	27.6629
1.5114	2.1030	2.9193	4.0845	5.7741	8.1265	11.3551	15.7185	21.1913	27.6308
1.5065	2.1088	2.9460	4.1066	5.7494	8.1103	11.3478	15.7192	21.2165	27.4928
1.5117	2.0939	2.9228	4.1079	5.7561	8.1001	11.3526	15.6246	21.2550	27.5498
1.5073	2.0819	2.9090	4.0884	5.7241	8.0705	11.2920	15.6186	21.2401	27.4160
1.5009	2.0902	2.8949	4.0760	5.7509	8.0493	11.2993	15.5453	21.0629	27.2559
1.4989	2.0687	2.8836	4.0430	5.6565	8.0098	11.1608	15.5100	20.9994	27.2027
1.4758	2.0366	2.8635	3.9879	5.5860	7.9295	11.0619	15.1843	20.7220	27.0838
1.4469	2.0011	2.7760	3.9038	5.4832	7.7322	10.8192	15.0323	20.4200	26.5067
1.3904	1.9233	2.6729	3.7482	5.2617	7.4185	10.4250	14.5963	19.6501	25.5817
1.3039	1.8025	2.5019	3.5168	4.9837	7.0290	9.7844	13.6870	18.5990	24.2034
1.1787	1.6232	2.2542	3.1578	4.4218	6.3096	8.8949	12.4209	16.9173	22.1389
0.9879	1.3774	1.9128	2.6780	3.7750	5.3895	7.5992	10.6538	14.5778	19.0252
0.7652	1.0602	1.4741	2.0768	2.9331	4.1695	5.9146	8.3144	11.4569	15.0440
0.5158	0.7082	0.9910	1.4071	1.9908	2.8300	4.0271	5.7008	7.8525	10.4241
0.2798	0.3887	0.5428	0.7661	1.0950	1.5544	2.2266	3.1685	4.3738	5.7960
0.1100	0.1528	0.2146	0.3016	0.4283	0.6178	0.8848	1.2602	1.7554	2.3282
0.0258	0.0361	0.0506	0.0719	0.1033	0.1485	0.2124	0.3023	0.4211	0.5623

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0.0028	0.0039	0.0056	0.0079	0.0113	0.0163	0.0234	0.0333	0.0463	0.0616
0.0001	0.0001	0.0002	0.0003	0.0004	0.0006	0.0008	0.0011	0.0016	0.0021

gridRprobe(1:20,11:20) x10^5 =

33.7326	38.6373	40.5204	39.3855	35.3638	29.8165	23.8897	18.9350	13.9330	11.0341
33.7446	38.7735	40.6830	39.2602	35.0910	29.8531	23.9767	18.4762	14.2771	11.0044
33.7279	38.3731	40.3960	39.3930	35.4466	30.1286	24.0857	18.8341	14.7092	10.9173
33.8172	38.6260	40.4958	39.4681	35.4686	29.4807	24.0782	18.6430	14.3358	10.7975
33.8261	38.5704	40.2056	39.2048	35.1713	29.6314	24.0409	18.3903	13.9332	10.2679
33.5670	38.2684	40.3266	39.0483	34.9500	29.1860	23.7121	18.3996	14.1294	10.9318
33.5697	37.9888	39.8441	38.7995	34.7685	29.1842	23.2917	18.1802	13.8229	10.0878
33.2904	37.7294	39.5146	38.4346	34.0965	28.7035	22.7764	17.6805	13.3975	9.8870
32.5986	36.9280	38.7559	37.2295	33.3040	28.2670	22.1673	16.9430	12.9890	9.5243
31.5024	35.9831	37.4829	36.0936	32.0139	26.6947	21.2088	15.7638	11.5672	8.3414
29.7338	34.1152	35.4249	33.7830	29.8710	24.6203	19.0033	14.0652	9.9464	6.7420
27.2212	31.0675	32.1297	30.4186	26.6517	21.4290	16.3495	11.7483	7.9667	5.2441
23.4971	26.7384	27.5217	26.0341	22.2518	17.4489	12.8337	8.8970	5.6972	3.5409
18.6742	21.1525	21.5535	20.0770	16.8265	12.7515	9.0116	5.7994	3.5252	2.0293
12.8707	14.5297	14.7284	13.3643	10.8300	7.9609	5.2498	3.1506	1.7593	0.8784
7.2001	8.0827	8.0969	7.2077	5.6322	3.9153	2.4021	1.3365	0.6453	0.2827
2.8900	3.2467	3.2200	2.7954	2.1046	1.3713	0.7773	0.3788	0.1653	0.0629
0.7013	0.7842	0.7683	0.6529	0.4738	0.2922	0.1527	0.0663	0.0242	0.0075
0.0767	0.0868	0.0847	0.0711	0.0501	0.0292	0.0140	0.0054	0.0016	0.0004
0.0026	0.0029	0.0029	0.0024	0.0017	0.0009	0.0004	0.0001	0.0000	0.0000

Non-contact probe getRdprobe()

The subroutine getRdprobe() calculates the total diffuse R_d then the factor f_{esc} for a particular fiber spot size (radius a = h sin(q)) as the probe is held at a height (h) above the tissue. See Eq. 1 in the manuscript. The analysis grids gridRd and gridfesc are listed below for the case of a half-angle of light delivery q = 24.8° and a height h =1 cm. The 2D interpolation yields values for R_d and f_{esc}, and the product R_df_{esc} is the probe response to be used in least-squares fitting of the data. The effect of f_{coll} is here ignored since it becomes incorporated in the scaling factor K during the least-squares fitting. The least-squares fitting is a standard routine and is not included in this Supplement. The subroutine is listed:

```
function Rdprobe = getRdprobe(mua,musp,LMSP,LMA,gridRd,gridfesc)
lmua = log10(mua);
lmusp = log10(musp);
Rd = griddata(LMSP,LMA,gridRd,lmusp,lmua);
fesc = griddata(LMSP,LMA,gridfesc,lmusp,lmua);
Rdprobe = Rd.*fesc;
```

which uses the following array gridRd() that holds the values for $R_d(m_a,m_s')$ and the arrray gridfesc() that holds the values of $f_{esc}(m_a,m_s')$:

gridRd(1:20,1:10) =

0.8294	0.8398	0.8761	0.8793	0.8792	0.9043	0.9010	0.9206	0.8985	0.9318
0.7857	0.8141	0.8309	0.8448	0.8626	0.8836	0.8830	0.8963	0.9111	0.9190
0.7370	0.7577	0.7843	0.8105	0.8231	0.8413	0.8639	0.8754	0.9007	0.9085
0.6671	0.7043	0.7324	0.7624	0.7856	0.8119	0.8354	0.8498	0.8637	0.8713
0.5949	0.6335	0.6668	0.7010	0.7292	0.7556	0.7850	0.8119	0.8208	0.8496
0.5009	0.5494	0.5884	0.6260	0.6687	0.6977	0.7295	0.7545	0.7815	0.8102
0.4080	0.4529	0.5021	0.5475	0.5875	0.6286	0.6663	0.7057	0.7300	0.7555
0.3098	0.3558	0.4038	0.4529	0.5009	0.5440	0.5871	0.6284	0.6598	0.7040

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0.2202 0.2637 0.3112 0.3603 0.4018 0.4577 0.5033 0.5495 0.5759 0.6171
0.1431 0.1802 0.2197 0.2591 0.3104 0.3533 0.3978 0.4541 0.5018 0.5452
0.0849 0.1113 0.1427 0.1780 0.2199 0.2636 0.3088 0.3567 0.4041 0.4457
0.0452 0.0621 0.0847 0.1104 0.1421 0.1772 0.2177 0.2597 0.3096 0.3539
0.0220 0.0319 0.0448 0.0618 0.0845 0.1105 0.1424 0.1782 0.2148 0.2614
0.0103 0.0152 0.0219 0.0314 0.0448 0.0616 0.0828 0.1098 0.1407 0.1769
0.0050 0.0072 0.0103 0.0151 0.0218 0.0313 0.0442 0.0614 0.0831 0.1107
0.0025 0.0035 0.0049 0.0071 0.0102 0.0151 0.0216 0.0311 0.0439 0.0610
0.0013 0.0018 0.0025 0.0035 0.0049 0.0071 0.0103 0.0148 0.0216 0.0312
0.0007 0.0009 0.0013 0.0017 0.0025 0.0035 0.0049 0.0070 0.0102 0.0149
0.0004 0.0005 0.0007 0.0009 0.0013 0.0018 0.0024 0.0034 0.0049 0.0070
0.0002 0.0003 0.0004 0.0005 0.0007 0.0009 0.0012 0.0018 0.0024 0.0034

gridRd(1:20,11:20) =

0.9480 0.9487 0.9508 0.9473 0.9568 0.9535 0.9604 0.9671 0.9528 0.9592
0.9361 0.9295 0.9286 0.9362 0.9393 0.9525 0.9561 0.9653 0.9529 0.9603
0.9193 0.9209 0.9300 0.9372 0.9378 0.9442 0.9446 0.9588 0.9555 0.9607
0.8980 0.8973 0.9139 0.9163 0.9244 0.9290 0.9396 0.9424 0.9433 0.9522
0.8649 0.8759 0.8901 0.9037 0.9071 0.9180 0.9232 0.9291 0.9428 0.9424
0.8257 0.8503 0.8564 0.8906 0.8974 0.9018 0.9125 0.9085 0.9084 0.9443
0.7845 0.8081 0.8298 0.8461 0.8630 0.8862 0.8933 0.8984 0.9128 0.9283
0.7329 0.7609 0.7883 0.8122 0.8339 0.8478 0.8634 0.8804 0.8863 0.9010
0.6647 0.7042 0.7206 0.7654 0.7865 0.8078 0.8581 0.8404 0.8587 0.9047
0.5872 0.6245 0.6729 0.6950 0.7470 0.7448 0.8042 0.8177 0.8266 0.8643
0.5019 0.5332 0.5794 0.6131 0.6616 0.6776 0.7444 0.7514 0.7801 0.8170
0.4011 0.4522 0.4966 0.5429 0.5771 0.6179 0.6668 0.6886 0.7393 0.7683
0.3058 0.3526 0.3973 0.4486 0.4938 0.5388 0.5786 0.6160 0.6535 0.6853
0.2175 0.2611 0.3059 0.3518 0.4006 0.4441 0.4962 0.5391 0.5852 0.6207
0.1401 0.1762 0.2180 0.2582 0.3049 0.3527 0.4041 0.4507 0.4970 0.5412
0.0820 0.1092 0.1401 0.1743 0.2161 0.2575 0.3000 0.3484 0.3922 0.4448
0.0443 0.0604 0.0818 0.1084 0.1390 0.1747 0.2146 0.2560 0.3026 0.3499
0.0214 0.0306 0.0436 0.0602 0.0817 0.1071 0.1373 0.1730 0.2139 0.2576
0.0101 0.0147 0.0214 0.0306 0.0435 0.0599 0.0814 0.1075 0.1386 0.1723
0.0048 0.0070 0.0101 0.0146 0.0210 0.0304 0.0427 0.0590 0.0814 0.1068

gridfesc(1:20,1;10) =

0.0229 0.0377 0.0388 0.0573 0.0957 0.1135 0.1228 0.2466 0.3059 0.4797
0.0305 0.0353 0.0466 0.0682 0.0909 0.1306 0.1547 0.2378 0.3042 0.3928
0.0289 0.0335 0.0535 0.0693 0.0949 0.1353 0.1824 0.2387 0.2909 0.3931
0.0300 0.0399 0.0523 0.0685 0.1005 0.1380 0.1715 0.2593 0.3253 0.4206
0.0345 0.0469 0.0639 0.0752 0.1128 0.1562 0.1907 0.2545 0.3065 0.3983
0.0388 0.0537 0.0637 0.0873 0.1167 0.1538 0.2076 0.2560 0.3395 0.4209
0.0492 0.0605 0.0768 0.1014 0.1250 0.1771 0.2192 0.2928 0.3626 0.4562
0.0611 0.0749 0.0896 0.1182 0.1551 0.1917 0.2467 0.3172 0.3904 0.4776
0.0797 0.0956 0.1123 0.1397 0.1771 0.2264 0.2710 0.3530 0.4176 0.4931
0.1163 0.1297 0.1490 0.1693 0.2188 0.2564 0.3164 0.4000 0.4670 0.5526
0.1717 0.1850 0.1981 0.2269 0.2695 0.3139 0.3786 0.4513 0.5228 0.5939
0.2684 0.2729 0.2851 0.3052 0.3387 0.3881 0.4440 0.5096 0.5899 0.6540

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0.4183 0.4065 0.4119 0.4167 0.4486 0.4903 0.5394 0.5972 0.6535 0.7148
0.6071 0.5913 0.5766 0.5753 0.5939 0.6117 0.6460 0.6905 0.7368 0.7865
0.7987 0.7807 0.7637 0.7517 0.7474 0.7504 0.7695 0.7909 0.8230 0.8534
0.9235 0.9147 0.9007 0.8903 0.8813 0.8813 0.8817 0.8872 0.8975 0.9131
0.9802 0.9792 0.9729 0.9702 0.9650 0.9615 0.9573 0.9555 0.9578 0.9610
1.0004 1.0003 0.9987 0.9978 0.9966 0.9950 0.9932 0.9916 0.9909 0.9906
1.0051 1.0052 1.0050 1.0047 1.0045 1.0045 1.0045 1.0037 1.0037 1.0030
1.0060 1.0060 1.0062 1.0059 1.0059 1.0062 1.0058 1.0058 1.0058 1.0059

gridfesc(1:20,11;20) =

0.4893 0.5511 0.6189 0.7029 0.7361 0.7549 0.8732 0.9131 0.9034 0.9693
0.4878 0.5581 0.6222 0.6920 0.7397 0.8010 0.8598 0.9125 0.9298 0.9452
0.4820 0.5510 0.6328 0.7011 0.7616 0.7964 0.8601 0.9212 0.9259 0.9553
0.4817 0.5652 0.6378 0.7041 0.7826 0.8254 0.8814 0.9213 0.9262 0.9642
0.4871 0.5790 0.6624 0.7181 0.7835 0.8317 0.8891 0.9100 0.9464 0.9650
0.5042 0.6007 0.6766 0.7523 0.7816 0.8677 0.8689 0.9379 0.9556 0.9363
0.5379 0.6070 0.6879 0.7597 0.8172 0.8810 0.8853 0.9143 0.9515 0.9549
0.5608 0.6357 0.7237 0.7846 0.8320 0.8765 0.9179 0.9302 0.9675 0.9798
0.6059 0.6725 0.7421 0.7924 0.8690 0.9170 0.9316 0.9601 0.9657 0.9855
0.6185 0.7052 0.7763 0.8312 0.8860 0.9041 0.9272 0.9641 0.9764 0.9898
0.6701 0.7429 0.8040 0.8515 0.8992 0.9265 0.9509 0.9783 0.9777 0.9901
0.7195 0.7840 0.8443 0.8880 0.9189 0.9447 0.9651 0.9819 0.9947 0.9927
0.7717 0.8317 0.8740 0.9158 0.9396 0.9547 0.9735 0.9858 0.9940 0.9985
0.8275 0.8751 0.9069 0.9337 0.9564 0.9713 0.9858 0.9946 0.9998 0.9998
0.8844 0.9120 0.9388 0.9577 0.9709 0.9841 0.9940 0.9994 1.0033 1.0039
0.9317 0.9471 0.9630 0.9760 0.9866 0.9929 1.0002 1.0012 1.0034 1.0051
0.9678 0.9757 0.9832 0.9900 0.9959 0.9993 1.0029 1.0042 1.0046 1.0060
0.9920 0.9934 0.9964 0.9999 1.0017 1.0037 1.0047 1.0058 1.0057 1.0060
1.0031 1.0031 1.0038 1.0043 1.0049 1.0054 1.0058 1.0057 1.0063 1.0061
1.0058 1.0056 1.0056 1.0059 1.0061 1.0058 1.0063 1.0061 1.0063 1.0063

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