Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Information

Generation of flow and droplets with ultra-long-range linear concentration gradient

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Supplementary Videos

Video S1 The generation of the flow with concentration gradient.

Video S2 The generation of a library of droplets with varying concentration.

Supplementary Figures

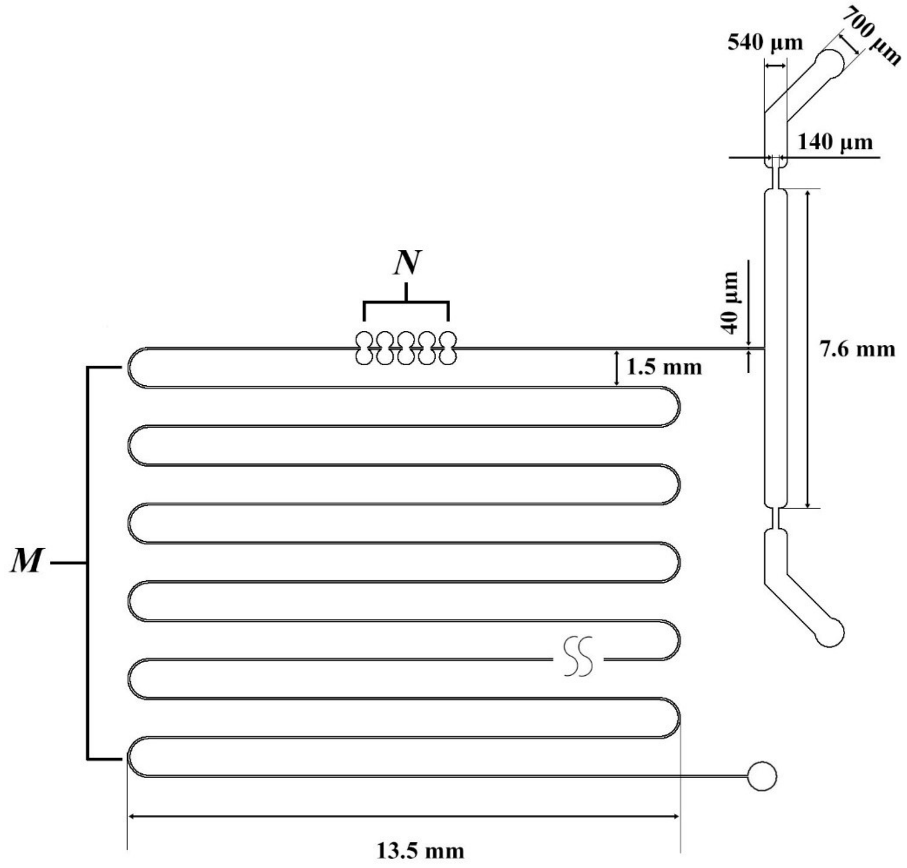

Figure S1 The microfluidic structure of the concentration-gradient flow generator.

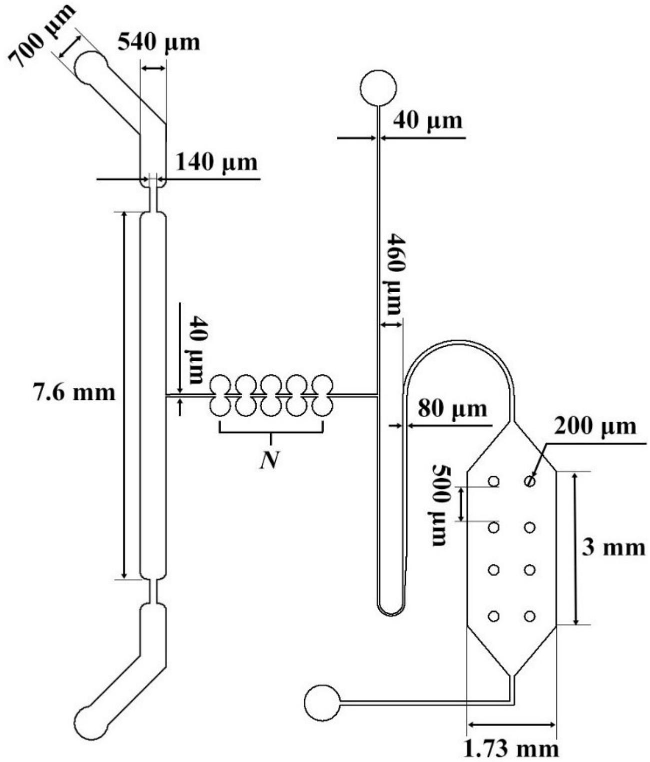

Figure S2 The microfluidic structure of the concentration-gradient droplet generator.

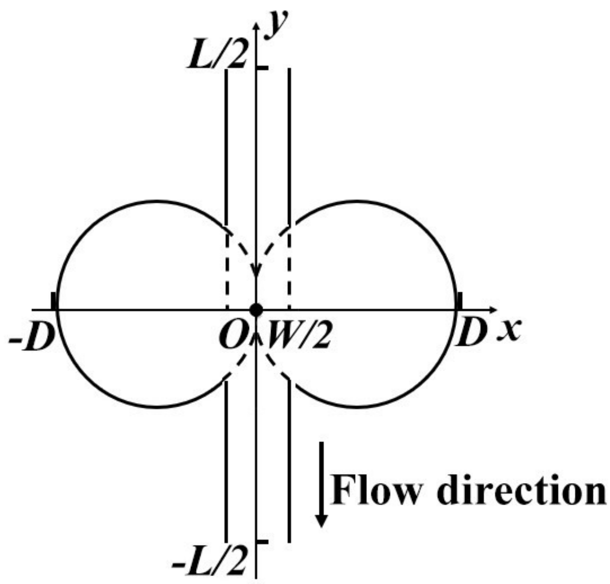

Figure S3 The coordinate system of each stage of the concentration gradient generator.

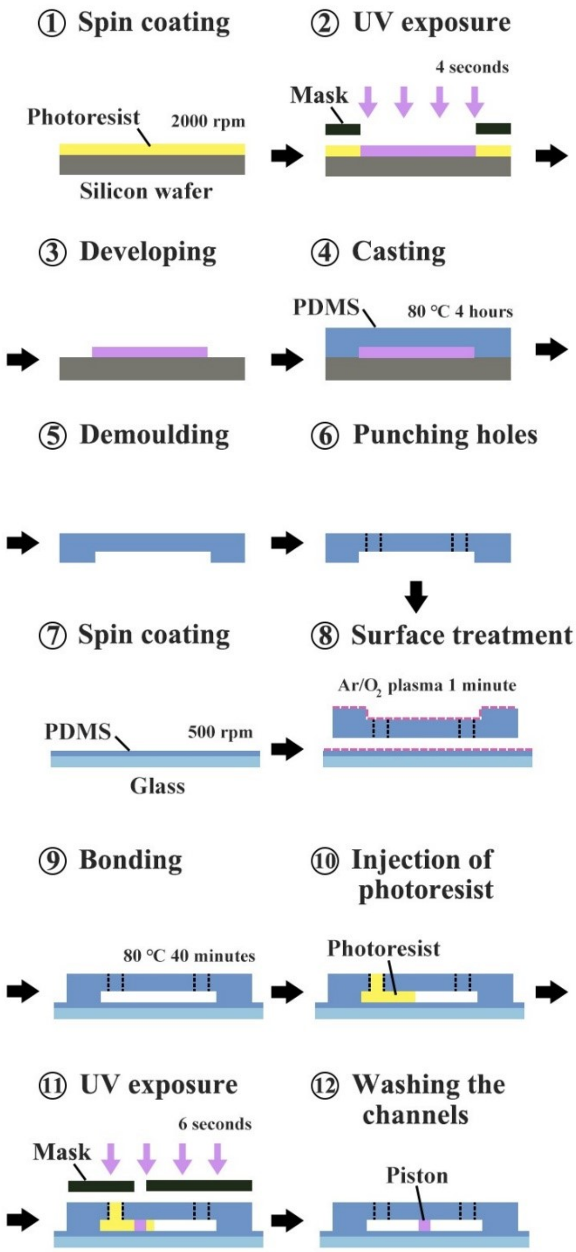

Figure S4 Fabrication procedure of the microfluidic chip.

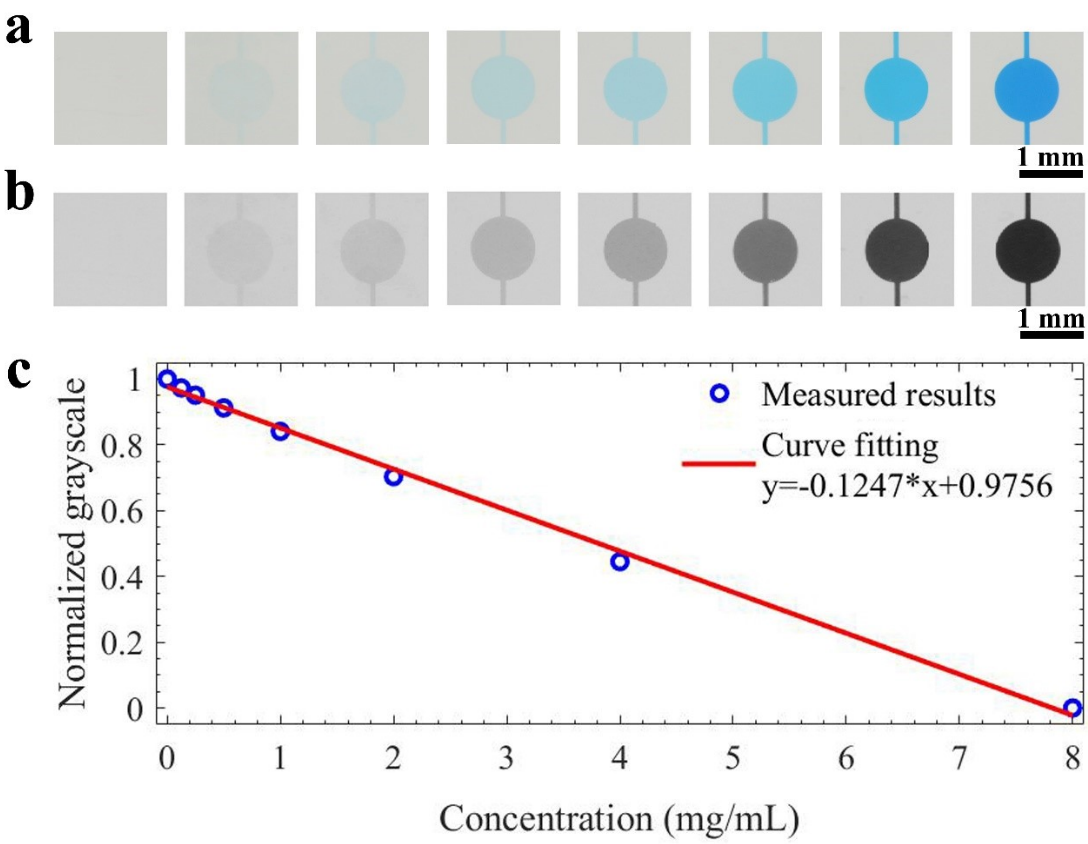

Figure S5 The relation between the color and the concentration of the solvent dye.

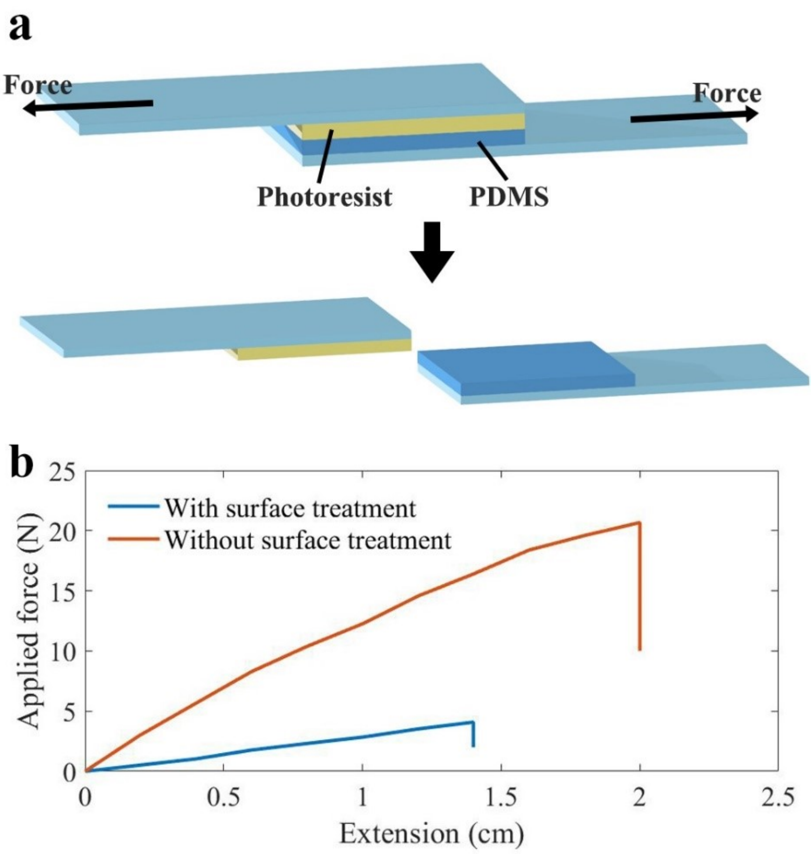

Figure S6 Measurement of the adhesion between PDMS and photoresist.

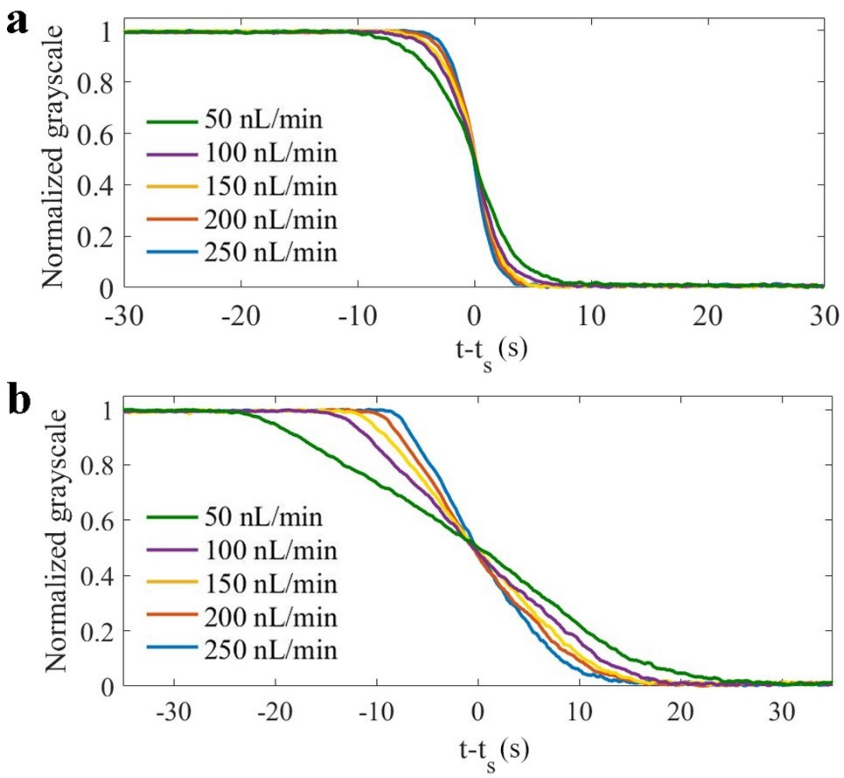

Figure S7 Gradient profile by using the concentration gradient generators with cavities of different diameters. The concentration gradient generator has 5 stages (N=5) of cavities in series. The width of the main channel is W=40 μm. (a) The diameter of cavities is D=200 μm. (b) The diameter of cavities is D=400 μm. After triggering the switch, the time duration for the grayscale change from 100% to 50% is denoted as t_S, *i.e.* $t=t_S$ is the moment that the grayscale equals to 50%.

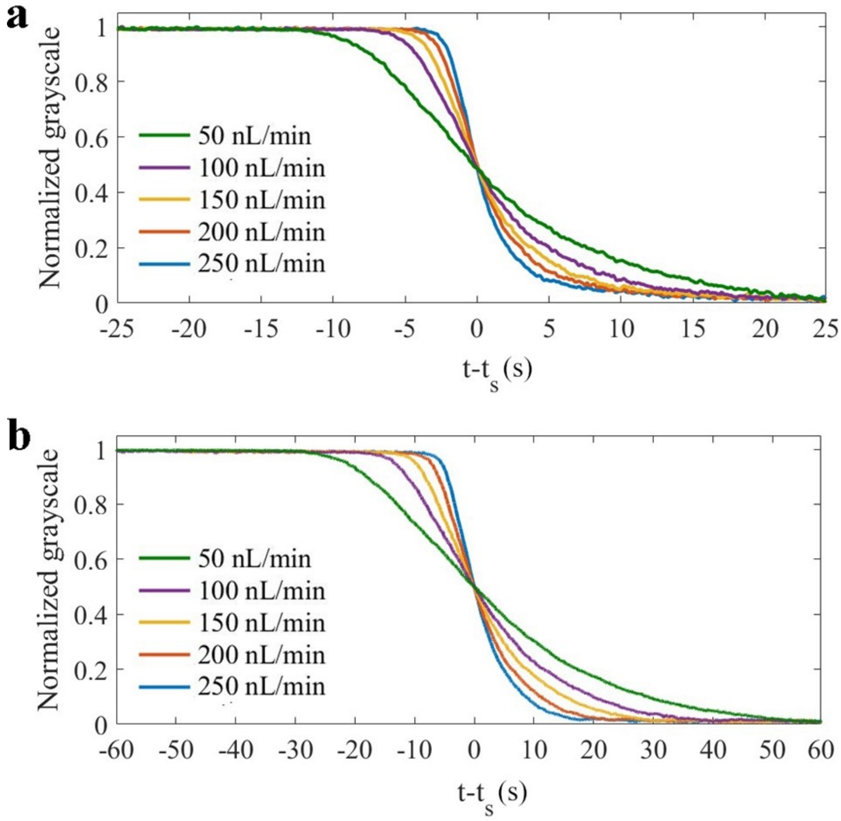

Figure S8 Gradient profile by using the concentration gradient generators with cavities of different number of stages. The diameter of the cavities are D=300 μm. The width of the main channel is W=40 μm. (a) The concentration gradient generator has 5 stages (N=5). (b) The generator has 10 stages (N=10).

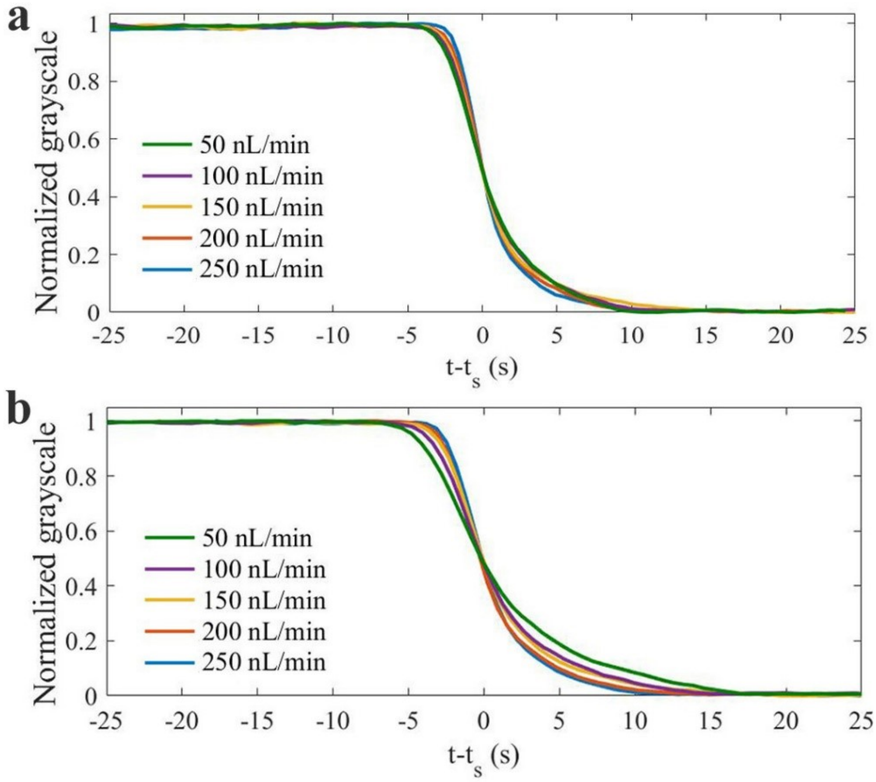

Figure S9 Gradient profile by using the concentration gradient generator with main channel of different width. The concentration gradient generator has 5 stages (N=5) of cavities in series. The diameter of the cavities are D=300 μm. (a) The width of the main channel is W=60 μm. (b) The width of the main channel is W=80 μm.

Supplementary Tables

Table S1 Calculation of the length of the concentration gradient

Number of stage, *N*	Width of main channel, *W* (μm)	Diameter of cavities, *D* (μm)	Flow rate, *Q* (nL/min)	Length of concentration gradient, *l* (mm)		
				Test 1	**Test 2**	**Test 3**
5	40	200	50	4.64	4.51	4.55
			100	6.46	6.27	6.66
			150	9.22	9.42	9.50
			200	9.80	9.56	10.11
			250	10.42	10.72	10.78
		300	50	10.71	9.81	10.08
			100	14.00	13.04	13.32
			150	15.63	14.39	14.81
			200	16.75	16.79	16.27
			250	15.63	14.63	14.88
		400	50	16.88	16.39	17.38
			100	23.63	22.85	24.44
			150	30.19	29.25	31.08
			200	36.00	35.02	37.07
			250	37.76	36.50	38.88
	60	300	50	6.94	6.75	7.20
			100	10.42	10.02	10.93
			150	13.54	13.23	14.12
			200	15.28	14.98	15.53
			250	19.10	18.72	19.57
	80	300	50	3.91	3.81	4.02
			100	7.81	7.67	8.01
			150	10.94	10.77	11.22
			200	13.54	13.10	14.11
			250	13.02	12.72	13.40
10	40	300	50	24.58	23.98	24.32
			100	32.58	29.71	30.10
			150	36.81	37.63	37.68
			200	35.33	38.08	38.42
			250	34.38	37.83	37.06

Table S2 Linear regression analysis of the concentration gradient in Figure. S7, Figure S8 and Figure S9.

Number of stage, *N*	**Width of main channel, *W* (µm)**	**Diameter of cavities, *D* (µm)**	**Flow rate, *Q* (nL/min)**	**Slope, *k***	**y-intercept, *b***	R^2	***RMSE***
5	40	200	50	-0.1004	0.4968	0.985	0.032
			100	-0.1632	0.5021	0.986	0.031
			150	-0.1893	0.4932	0.981	0.037
			200	-0.1932	0.5047	0.981	0.036
			250	-0.1979	0.5027	0.988	0.029
		300	50	-0.1934	0.5003	0.992	0.025
			100	-0.2021	0.5080	0.980	0.037
			150	-0.2105	0.5028	0.965	0.052
			200	-0.2247	0.5067	0.980	0.037
			250	-0.2113	0.5006	0.968	0.049
		400	50	-0.2261	0.4957	0.997	0.014
			100	-0.2579	0.5038	0.997	0.013
			150	-0.2802	0.5093	0.997	0.013
			200	-0.2926	0.5065	0.988	0.026
			250	-0.3027	0.5048	0.992	0.021
	60	300	50	-0.1692	0.5023	0.977	0.031
			100	-0.1977	0.5041	0.971	0.037
			150	-0.2023	0.4985	0.966	0.041
			200	-0.2156	0.5026	0.976	0.033
			250	-0.2297	0.5009	0.963	0.048
	80	300	50	-0.0819	0.5068	0.987	0.027
			100	-0.1721	0.5071	0.973	0.033
			150	-0.1994	0.5014	0.977	0.029
			200	-0.2033	0.4986	0.964	0.043
			250	-0.2017	0.5017	0.966	0.040
10	40	300	50	-0.2587	0.5017	0.970	0.043
			100	-0.2861	0.5047	0.974	0.040
			150	-0.2940	0.5057	0.980	0.031
			200	-0.2912	0.5064	0.974	0.040
			250	-0.2871	0.5016	0.975	0.042

Table S3 Evaluation of the linearity of the concentration gradient.

Number of stage, *N*	Width of main channel, *W* (μm)	Diameter of cavities, *D* (μm)	Flow rate, *Q* (nL/min)	Linearity evaluation R^2/*RMSE* Test 1	Test 2	Test 3
5	40	200	50	0.985/0.032	0.992/0.021	0.975/0.042
			100	0.986/0.031	0.985/0.029	0.970/0.044
			150	0.981/0.037	0.972/0.039	0.981/0.037
			200	0.981/0.036	0.959/0.047	0.972/0.043
			250	0.988/0.029	0.956/0.052	0.972/0.043
		300	50	0.992/0.025	0.957/0.051	0.966/0.045
			100	0.980/0.037	0.934/0.063	0.984/0.032
			150	0.965/0.052	0.936/0.061	0.976/0.044
			200	0.980/0.037	0.933/0.064	0.972/0.046
			250	0.968/0.049	0.933/0.065	0.986/0.033
		400	50	0.990/0.023	0.950/0.055	0.971/0.039
			100	0.971/0.041	0.975/0.039	0.982/0.031
			150	0.971/0.041	0.974/0.041	0.967/0.043
			200	0.978/0.033	0.975/0.039	0.973/0.038
			250	0.968/0.045	0.978/0.033	0.986/0.029
	60	300	50	0.977/0.031	0.983/0.030	0.991/0.022
			100	0.971/0.037	0.984/0.031	0.987/0.025
			150	0.966/0.041	0.982/0.033	0.973/0.032
			200	0.976/0.033	0.983/0.030	0.977/0.030
			250	0.963/0.048	0.978/0.035	0.981/0.028
	80	300	50	0.987/0.027	0.972/0.039	0.976/0.027
			100	0.973/0.033	0.983/0.033	0.971/0.029
			150	0.977/0.029	0.972/0.039	0.981/0.025
			200	0.964/0.043	0.976/0.037	0.966/0.043
			250	0.966/0.040	0.964/0.041	0.971/0.029
10	40	300	50	0.970/0.043	0.976/0.038	0.982/0.033
			100	0.974/0.040	0.965/0.046	0.980/0.034
			150	0.980/0.031	0.960/0.049	0.977/0.036
			200	0.974/0.040	0.956/0.051	0.979/0.034
			250	0.975/0.042	0.957/0.051	0.981/0.034