Electronic Supplementary Material (ESI) for Analyst.
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Electronic Supplementary Information

Learning-based automatic sensing and size classification of microparticles using smartphone holographic microscopy

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Features	1.998 μm (n=400)	7.22 μm (n=400)	9.78 μm (n=400)	14.92 μm (n=400)	30.04 μm (n=400)	50.00 μm (n=400)
Projection images						
1. Perimeter (μm)	16.24±5.40	28.21±6.06	32.77±3.50	45.02±5.04	92.97±5.27	149.73±7.50
2. Projected area (μm^2)	28.08±8.48	78.24±14.97	118.23±14.49	212.78±32.50	881.91±55.83	2190.22±127.71
In-focus images						
3. Width (μm)	3.31±0.90	6.07±1.21	8.97±2.58	12.32±3.82	34.12±6.32	44.45±10.90
4. Maximum intensity	0.27±0.03	0.34±0.05	0.42±0.07	0.48±0.08	0.57±0.17	0.88±0.19
5. Average intensity	0.015±0.003	0.030±0.003	0.033±0.004	0.042±0.006	0.12±0.03	0.22±0.05
6. S.D.	0.013±0.005	0.025±0.004	0.037±0.005	0.043±0.008	0.084±0.01	0.094±0.02
Raw intensity profiles along the line passing through the centers of particles of in-focus images (RIP)						
7. x = -29.64 μm	0.092±0.039	0.030±0.011	0.030±0.012	0.038±0.015	0.036±0.013	0.035±0.014
8. x = -28.50 μm	0.112±0.046	0.029±0.010	0.031±0.011	0.037±0.013	0.036±0.013	0.035±0.015
9. x = -27.36 μm	0.133±0.051	0.032±0.012	0.030±0.010	0.036±0.012	0.037±0.014	0.035±0.014
10. x = -26.22 μm	0.172±0.052	0.035±0.014	0.029±0.009	0.037±0.013	0.037±0.015	0.034±0.015
11. x = -25.08 μm	0.216±0.059	0.036±0.015	0.030±0.013	0.037±0.013	0.037±0.017	0.036±0.014
12. x = -23.94 μm	0.248±0.056	0.035±0.017	0.033±0.023	0.036±0.013	0.038±0.018	0.035±0.014
13. x = -22.80 μm	0.255±0.050	0.033±0.016	0.034±0.035	0.038±0.015	0.038±0.018	0.035±0.014
14. x = -21.66 μm	0.253±0.049	0.037±0.017	0.037±0.041	0.038±0.015	0.037±0.018	0.034±0.014
15. x = -20.52 μm	0.248±0.054	0.051±0.022	0.037±0.041	0.038±0.017	0.038±0.019	0.035±0.014
16. x = -19.38 μm	0.232±0.045	0.063±0.026	0.038±0.043	0.038±0.018	0.038±0.019	0.035±0.015
17. x = -18.24 μm	0.228±0.049	0.070±0.030	0.039±0.049	0.038±0.018	0.038±0.018	0.034±0.015
18. x = -17.10 μm	0.231±0.051	0.085±0.035	0.040±0.054	0.039±0.016	0.038±0.016	0.035±0.016
19. x = -15.96 μm	0.231±0.050	0.126±0.041	0.040±0.053	0.039±0.015	0.038±0.017	0.036±0.018
20. x = -14.82 μm	0.230±0.048	0.177±0.049	0.039±0.050	0.039±0.014	0.039±0.021	0.036±0.020
21. x = -13.68 μm	0.229±0.053	0.220±0.056	0.042±0.046	0.039±0.014	0.040±0.022	0.036±0.024
22. x = -12.54 μm	0.220±0.044	0.241±0.058	0.044±0.042	0.041±0.017	0.040±0.020	0.038±0.026
23. x = -11.40 μm	0.221±0.041	0.236±0.057	0.047±0.037	0.044±0.020	0.042±0.019	0.040±0.028
24. x =-10.26 μm	0.236±0.055	0.227±0.053	0.051±0.033	0.051±0.024	0.045±0.019	0.039±0.030
25. x = -9.12 μm	0.248±0.074	0.226±0.053	0.061±0.031	0.059±0.025	0.047±0.019	0.039±0.032

26. x = -7.98 μm	0.262±0.085	0.230±0.057	0.103±0.030	0.067±0.025	0.051±0.022	0.042±0.034
27. x = -6.84 μm	0.273±0.088	0.220±0.056	0.157±0.043	0.078±0.029	0.054±0.023	0.043±0.035
28. x = -5.70 μm	0.251±0.083	0.202±0.051	0.194±0.051	0.115±0.031	0.065±0.027	0.047±0.037
29. x = -4.56 μm	0.233±0.089	0.188±0.058	0.198±0.055	0.163±0.049	0.083±0.028	0.056±0.036
30. x = -3.42 μm	0.253±0.134	0.193±0.051	0.200±0.053	0.197±0.057	0.110±0.034	0.063±0.036
31. x = -2.28 μm	0.360±0.153	0.250±0.101	0.234±0.063	0.236±0.049	0.172±0.044	0.082±0.037
32. x = -1.14 μm	0.538±0.183	0.380±0.176	0.283±0.102	0.292±0.088	0.252±0.048	0.158±0.036
33. x = 0.00 μm	0.631±0.228	0.463±0.183	0.303±0.121	0.323±0.130	0.292±0.049	0.215±0.035
34. x = 1.14 μm	0.554±0.215	0.399±0.152	0.269±0.084	0.282±0.081	0.228±0.048	0.151±0.037
35. x = 2.28 μm	0.364±0.182	0.262±0.091	0.236±0.055	0.225±0.055	0.145±0.045	0.075±0.039
36. x = 3.42 μm	0.265±0.156	0.177±0.060	0.223±0.054	0.195±0.059	0.098±0.033	0.056±0.038
37. x = 4.56 μm	0.225±0.126	0.165±0.049	0.213±0.054	0.160±0.043	0.075±0.027	0.052±0.037
38. x = 5.70 μm	0.246±0.103	0.184±0.048	0.182±0.051	0.109±0.034	0.060±0.024	0.045±0.036
39. x = 6.84 μm	0.276±0.100	0.207±0.046	0.135±0.040	0.077±0.028	0.054±0.022	0.045±0.034
40. x = 7.98 μm	0.282±0.097	0.218±0.047	0.082±0.028	0.062±0.024	0.052±0.021	0.044±0.033
41. x = 9.12 μm	0.263±0.078	0.215±0.047	0.053±0.025	0.056±0.023	0.048±0.019	0.042±0.031
42. x = 10.26 μm	0.238±0.055	0.215±0.048	0.049±0.026	0.050±0.022	0.043±0.018	0.039±0.031
43. x = 11.40 μm	0.237±0.053	0.228±0.052	0.046±0.026	0.045±0.021	0.040±0.019	0.039±0.028
44. x = 12.54 μm	0.230±0.048	0.238±0.055	0.039±0.025	0.043±0.020	0.040±0.022	0.038±0.027
45. x = 13.68 μm	0.227±0.050	0.230±0.054	0.035±0.025	0.042±0.019	0.040±0.022	0.037±0.024
46. x = 14.82 μm	0.233±0.056	0.204±0.049	0.039±0.032	0.040±0.017	0.039±0.019	0.036±0.022
47. x = 15.96 μm	0.230±0.051	0.157±0.040	0.041±0.038	0.038±0.014	0.038±0.018	0.036±0.020
48. x = 17.10 μm	0.227±0.048	0.108±0.033	0.040±0.039	0.039±0.014	0.038±0.017	0.036±0.018
49. x = 18.24 μm	0.227±0.051	0.077±0.027	0.037±0.035	0.039±0.015	0.038±0.017	0.036±0.017
50. x = 19.38 μm	0.233±0.045	0.062±0.026	0.037±0.036	0.039±0.016	0.039±0.019	0.036±0.018
51. x = 20.52 μm	0.244±0.046	0.054±0.026	0.036±0.034	0.039±0.017	0.038±0.019	0.036±0.017
52. x = 21.66 μm	0.249±0.051	0.045±0.020	0.036±0.028	0.038±0.015	0.038±0.019	0.036±0.017
53. x = 22.80 μm	0.252±0.053	0.037±0.013	0.035±0.022	0.038±0.014	0.038±0.017	0.036±0.016
54. x = 23.94 μm	0.240±0.057	0.037±0.014	0.034±0.015	0.038±0.014	0.038±0.016	0.035±0.014

55. x = 25.08 μm	0.212±0.061	0.037±0.013	0.032±0.010	0.038±0.013	0.037±0.014	0.035±0.013
56. x = 26.22 μm	0.172±0.050	0.035±0.011	0.030±0.010	0.038±0.014	0.038±0.014	0.036±0.013
57. x = 27.36 μm	0.129±0.042	0.033±0.012	0.030±0.013	0.038±0.013	0.038±0.015	0.035±0.013
58. x = 28.50 μm	0.102±0.038	0.032±0.012	0.031±0.012	0.037±0.015	0.037±0.015	0.034±0.012
59. x = 29.64 μm	0.094±0.038	0.034±0.012	0.033±0.013	0.037±0.7	0.037±0.015	0.034±0.012

Table S1. Summary of the features of six microparticles (n = 2400).

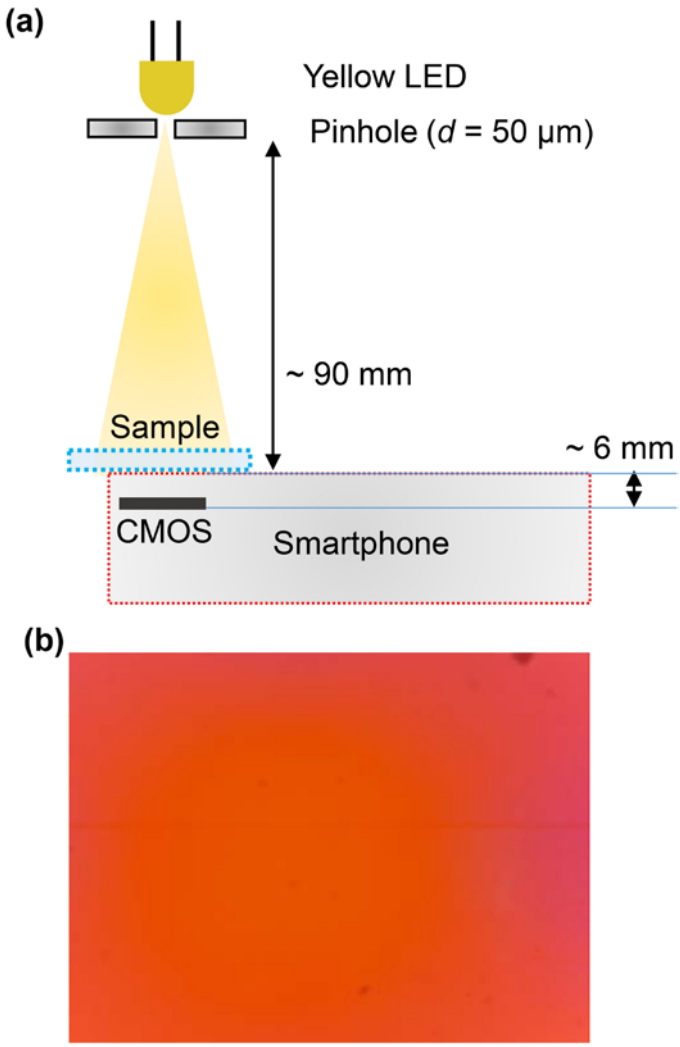

Figure S1. Imaging performance of the smartphone-based DIHM with a partially coherent beam. (a) Schematic diagram of the portable DIHM system with a yellow LED (λ = 590 nm, 3W) powered by a 3V coin battery. (b) Full FOV of a holographic image of 30 μm particles. No holographic signals were detected.

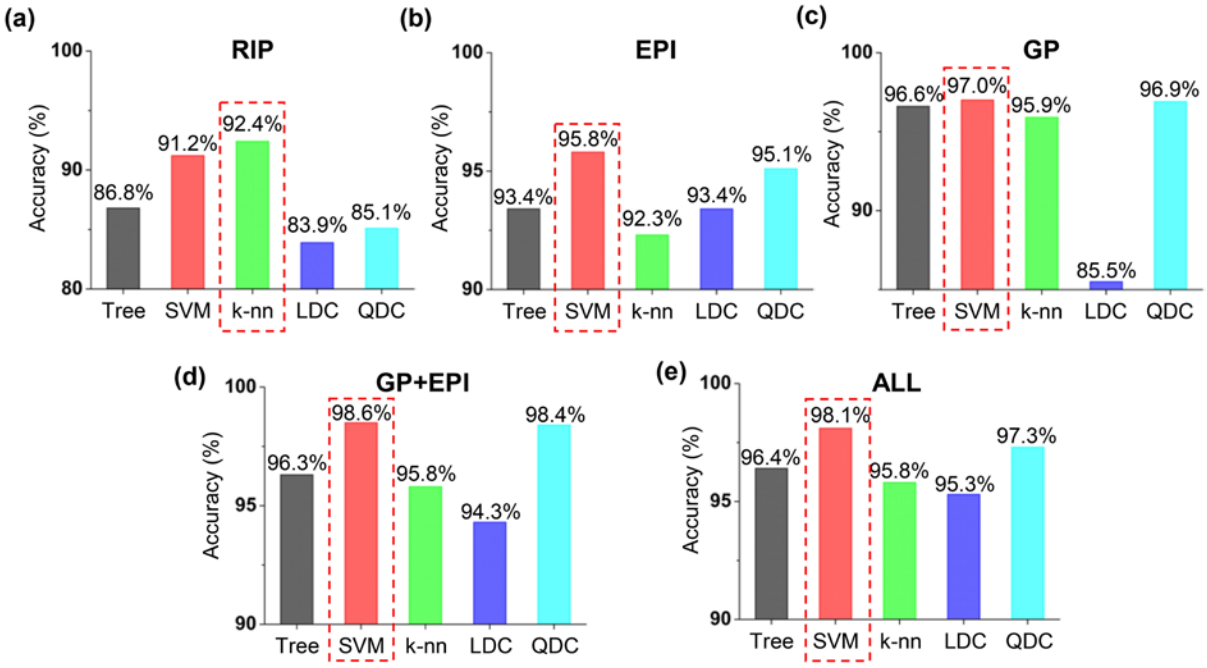

Figure S2. 25 classifiers extablished by varying machine learning algorithms and combinations of input features. (a) 5 classifiers trained by RIP, (b) 5 classifiers trained by EPI, (c) 5 classifiers trained by GP, (d) 5 classifiers trained by both GP and EPI, (e) 5 classifiers trained by all features.