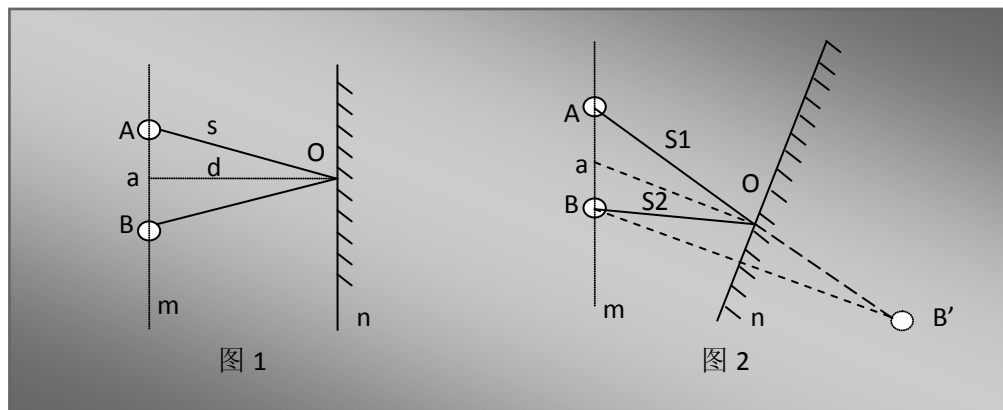


# 浅析超声波测距的两个探头间的距离对测距准确度的影响

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问：超声波测距时两个分立的探头间的距离为多少时所测距离的误差最小呢？

分析：A、B 点为两个探头，当两个探头平面与所测平面平行时，如图 1，由超声波测距原理知：超声波经 A 点发出后在 O 点反射后被 B 探头“收到”，超声波所走过的路程为 2S，由常用距离的算法，即  $S=ut/2$  得到的距离为 S，但是由图 1 很明显的，实际的距离为 d，所以  $d \neq S$ 。但当两个探头的距离 a 越小时这个误差就会变得很小。下面是当  $a=4\text{cm}$  时，所得的数据：

计算公式为：
$$S = \sqrt{\left(\frac{1}{2}a\right)^2 + d^2} = \sqrt{\frac{1}{4}a^2 + d^2} = \sqrt{4 + d^2}$$

实际距离(单位 d:

cm)

实际距离(单位 d: cm)	所测距离 (s)	绝对误差	相对误差
1	2.236067977	123.61%	123.61%
2	2.828427125	82.84%	41.42%
3	3.605551275	60.56%	20.19%
4	4.472135955	47.21%	11.80%
5	5.385164807	38.52%	7.70%
6	6.32455532	32.46%	5.41%
7	7.280109889	28.01%	4.00%
8	8.246211251	24.62%	3.08%
9	9.219544457	21.95%	2.44%
10	10.19803903	19.80%	1.98%
11	11.18033989	18.03%	1.64%
12	12.16552506	16.55%	1.38%
13	13.15294644	15.29%	1.18%
14	14.14213562	14.21%	1.02%
<b>15</b>	<b>15.13274595</b>	<b>13.27%</b>	<b>0.88%</b>
16	16.1245155	12.45%	0.78%
17	17.11724277	11.72%	0.69%
18	18.11077028	11.08%	0.62%
19	19.10497317	10.50%	0.55%
20	20.09975124	9.98%	0.50%
21	21.09502311	9.50%	0.45%
22	22.09072203	9.07%	0.41%

23	23. 08679276	8. 68%	0. 38%
24	24. 08318916	8. 32%	0. 35%
25	25. 07987241	7. 99%	0. 32%
26	26. 07680962	7. 68%	0. 30%
27	27. 07397274	7. 40%	0. 27%
28	28. 0713377	7. 13%	0. 25%
29	29. 06888371	6. 89%	0. 24%
30	30. 06659276	6. 66%	0. 22%
31	31. 06444913	6. 44%	0. 21%
32	32. 06243908	6. 24%	0. 20%
33	33. 06055051	6. 06%	0. 18%
34	34. 05877273	5. 88%	0. 17%
35	35. 05709629	5. 71%	0. 16%
36	36. 05551275	5. 55%	0. 15%
37	37. 05401463	5. 40%	0. 15%
38	38. 05259518	5. 26%	0. 14%
39	39. 05124838	5. 12%	0. 13%
40	40. 04996879	5. 00%	0. 12%
41	41. 0487515	4. 88%	0. 12%
42	42. 04759208	4. 76%	0. 11%
43	43. 0464865	4. 65%	0. 11%
44	44. 04543109	4. 54%	0. 10%
45	45. 04442252	4. 44%	0. 10%
46	46. 04345773	4. 35%	0. 09%
47	47. 04253395	4. 25%	0. 09%
48	48. 0416486	4. 16%	0. 09%
49	49. 04079934	4. 08%	0. 08%
50	50. 03998401	4. 00%	0. 08%
51	51. 03920062	3. 92%	0. 08%
52	52. 03844733	3. 84%	0. 07%
53	53. 03772242	3. 77%	0. 07%
54	54. 03702434	3. 70%	0. 07%
55	55. 03635162	3. 64%	0. 07%
56	56. 0357029	3. 57%	0. 06%
57	57. 03507693	3. 51%	0. 06%
58	58. 03447251	3. 45%	0. 06%
59	59. 03388857	3. 39%	0. 06%
60	60. 03332408	3. 33%	0. 06%
61	61. 03277808	3. 28%	0. 05%
62	62. 03224968	3. 22%	0. 05%
63	63. 03173804	3. 17%	0. 05%
64	64. 03124237	3. 12%	0. 05%
65	65. 03076195	3. 08%	0. 05%
66	66. 03029608	3. 03%	0. 05%
67	67. 0298441	2. 98%	0. 04%
68	68. 02940541	2. 94%	0. 04%
69	69. 02897942	2. 90%	0. 04%
70	70. 0285656	2. 86%	0. 04%
71	71. 02816343	2. 82%	0. 04%

72	72.02777242	2.78%	0.04%
73	73.02739212	2.74%	0.04%
74	74.02702209	2.70%	0.04%
75	75.02666193	2.67%	0.04%
76	76.02631123	2.63%	0.03%
77	77.02596965	2.60%	0.03%
78	78.02563681	2.56%	0.03%
79	79.0253124	2.53%	0.03%
80	80.02499609	2.50%	0.03%
81	81.0246876	2.47%	0.03%
82	82.02438662	2.44%	0.03%
83	83.02409289	2.41%	0.03%
84	84.02380615	2.38%	0.03%
85	85.02352616	2.35%	0.03%
86	86.02325267	2.33%	0.03%
87	87.02298547	2.30%	0.03%
88	88.02272434	2.27%	0.03%
89	89.02246907	2.25%	0.03%
90	90.02221948	2.22%	0.02%
91	91.02197537	2.20%	0.02%
92	92.02173656	2.17%	0.02%
93	93.02150289	2.15%	0.02%
94	94.02127419	2.13%	0.02%
95	95.0210503	2.11%	0.02%
96	96.02083107	2.08%	0.02%
97	97.02061637	2.06%	0.02%
98	98.02040604	2.04%	0.02%
99	99.02019996	2.02%	0.02%
100	100.019998	2.00%	0.02%
101	101.0198	1.98%	0.02%
102	102.019606	1.96%	0.02%
103	103.0194156	1.94%	0.02%
104	104.019229	1.92%	0.02%
105	105.0190459	1.90%	0.02%
106	106.0188662	1.89%	0.02%
107	107.01869	1.87%	0.02%
108	108.0185169	1.85%	0.02%
109	109.0183471	1.83%	0.02%
110	110.0181803	1.82%	0.02%

由上表可见相对误差在实际距离  $d$  小于 15cm 时还是很大的,所以两个探头间的距离也是影响测量精度的一个很重要的参数。(个人看法啊,请大家指正)

二、由图 2 知,当两个探头平面与所测平面不平行时,所得的距离误差就更大了,我就不分析了。