Sound direction estimation using two microphones

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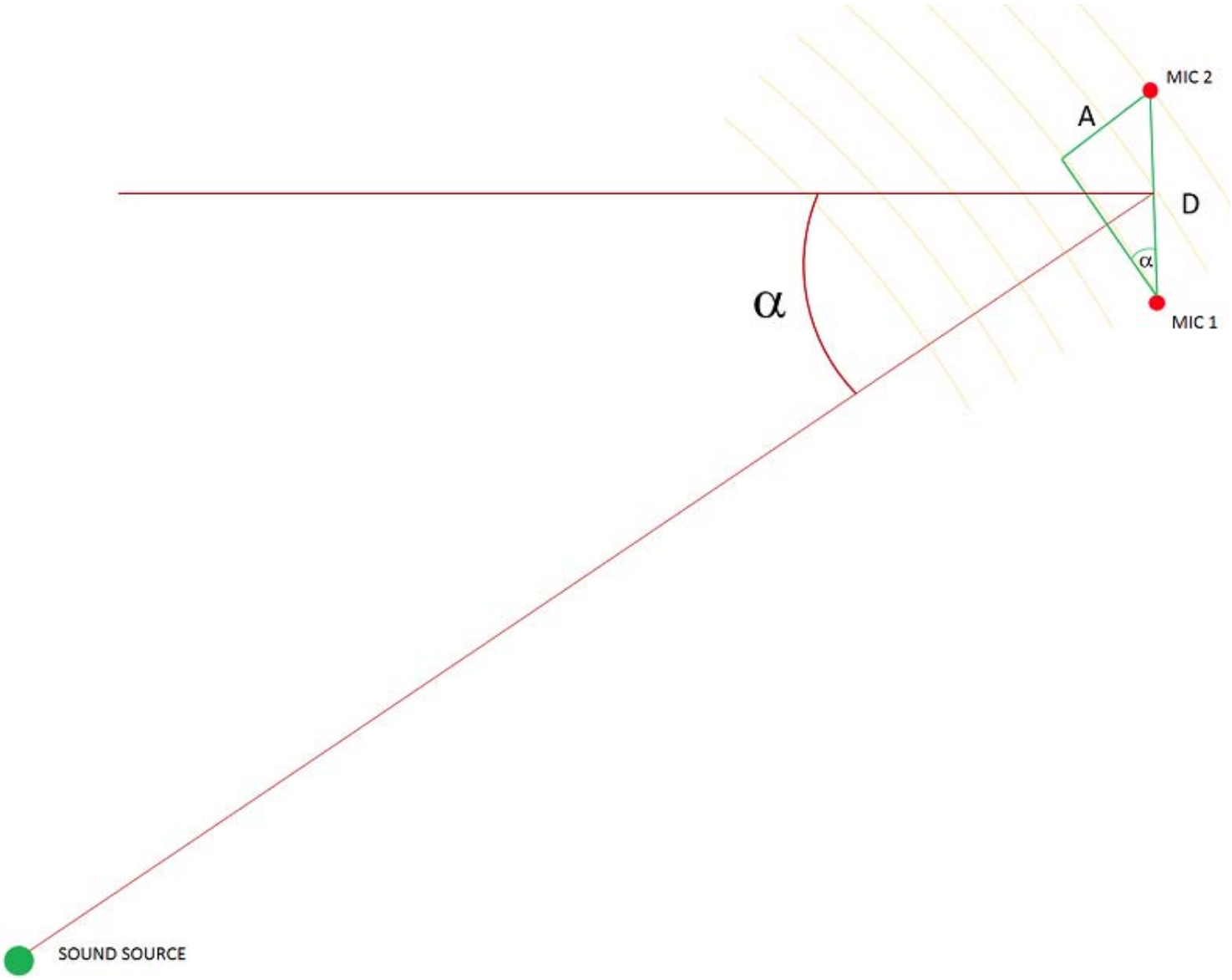
With two or more microphones the direction of the sound can be calculated if we know the distance and the time delay between

the microphones.

Let's look at the example setup (Image 1). The angle **alpha** can be calculated if we know the distance **D** between the microphones and the distance **A**. To calculate the distance A we need to know the speed of sound in air and the time delay between **MIC 1** and **MIC2**.

Image 1



Calculation

When the distance from the sound source is much larger than the distance between the microphones the angle can be estimated as:

$$\alpha = \boldsymbol{arcsin}\left(\frac{A}{D}\right)$$

$$v_{sound} = speed\ of\ sound \qquad 343.2\frac{m}{s}$$

$$\Delta R = sample\ delay\ between\ microphones$$

$$R = sample\ rate \qquad f.ex.\ 44100$$

$$A = \frac{\Delta R}{R} \cdot v_{sound}$$

$$\alpha = \boldsymbol{arcsin}\left(\frac{\Delta R}{R} \cdot \frac{v_{sound}}{D}\right)$$

The excel file angle.xlsx can be used to calculate the angle when we know the parameters - D, R and delta R.

		Sample Rate R		
D (m)	0.2	16000	44100	48000
Delay between microphones ΔR	0	0°	0°	0°
	1	6°	2°	2°
	2	12°	4°	4°
	3	19°	7°	6°
	4	25°	9°	8°
	5	32°	11°	10°
	6	40°	14°	12°
	7	49°	16°	14°
	8	59°	18°	17°
	9	75°	20°	19°
	10		23°	21°
	11		25°	23°
	12		28°	25°
	13		30°	28°
	14		33°	30°
	15		36°	32°
	16		39°	35°
	17		41°	37°
	18		44°	40°
	19		48°	43°
	20		51°	46°
	21		55°	49°
	22		59°	52°
	23		64°	55°
	24		69°	59°
	25		77°	63°
	26			68°
	27			75°

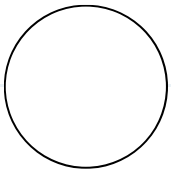
Additional information

Ivan Tashev: Sound Capture and Processing: Practical Approaches

GitHub

TDE source code

Excel files



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