Selective Particle Separation in Suspensions Using Acoustics

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Motivation

Acoustic separation is a relatively new method for the recovery of valuable particulate matter from suspensions and/or purification of liquid streams [1,2]. This technique of acoustic separation is mainly applied in biotechnology and medical technology [3,4]. Our aim is to apply this technique on separation of valuable suspensions in small to medium scale industrial water applications.

Concept

By creating ultrasonic standing waves in a suspension flow in a reactor, particles are forced to move to specific grid points in the reactor Figure 1).

Although in a standing wave the forces are small, this effect on particles is strong enough to manipulate particles for separation purposes. In addition to particle properties, such as radius, density and elastic modulus, this force also depends on excitation frequency, pressure amplitude and properties of ambient medium. Depending on the particle properties it is possible to move particles to a different position (Figure 2). Larger particles experience larger effects in terms of acoustic radiation force and drag resistance. They move to the target locations much faster than smaller particles (Figure 3). In addition to standing waves, travelling waves can be used, too (Figure 1).

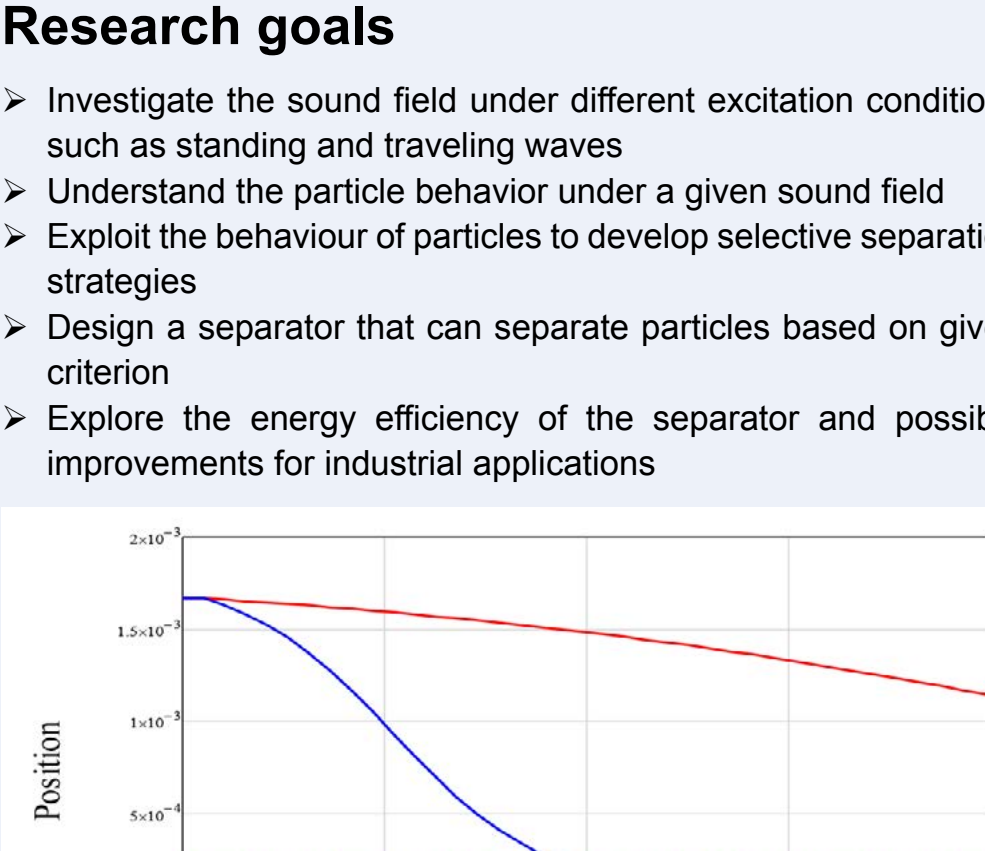

Figure 1. Particles can be selectively separeted with appropriate strategies based on their relative size, density etc.

Figure 2. Particles are trapped in either pressure nodes or antinodes

Research goals

- Investigate the sound field under different excitation conditions such as standing and traveling waves
- Understand the particle behavior under a given sound field
- Exploit the behaviour of particles to develop selective separation strategies
- Design a separator that can separate particles based on given criterion
- Explore the energy efficiency of the separator and possible improvements for industrial applications

Figure 3. Large particles experience larger force than small particles, thus providing options to selectively separate

References

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665874

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