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Measuring froth-pulp interactions at high-speed frame fates

L. Nugent
Undergraduate student, Department of Mining Engineering, West Virginia University, Morgantown, WV, USA

Background

Quantifying mass transport of bubbles from the pulp to the froth is a key metric for improving recovery rates in industrial flotation cells. Most existing flotation literature investigates froth behavior separately from particle attachment in the pulp. As noted by van Deventer, Feng and Burger (2001), very little research focuses on the behavior of the froth-pulp interface (FPI). Machine vision image analysis is widely used to extract quantitative measurements about froth characteristics or bubble behavior from film (Jahedsaravani, Marhaban and Massinaei, 2014; Aldrich et al., 2010).

Research aim

This project seeks to identify phenomena occurring at the FPI using images captured at high frame rates of 700 to 3,000 fps. The working hypothesis predicts images captured at high speeds will reveal bubble behavior impossible to observe with traditional 30 fps film.

Materials and methods

Images were captured using an Edgertronic high-speed camera focused on a laboratory flotation cell. Single bubbles were manually tracked and plotted frame by frame using Final Cut Pro software.

Results

Figure 1 demonstrates an example of bubble movement observable at high frame rates. The bubble follows an indirect path to join the froth, with its velocity and direction changing during travel. Each bubble tracked follows an independent path. Even bubbles generated at similar locations in the pulp follow substantially different paths throughout the flotation cell.

Conclusion

Images captured at high frame rates reveal a variety of phenomena that would be impossible to capture at traditional video speeds. High frame rates can overcome difficulties tracking bubbles in the turbulent pulp region where bubbles are visible only for fractions of a second. Further research will categorize these phenomena toward the development of predictive models of bubble behavior in the FPI.

References

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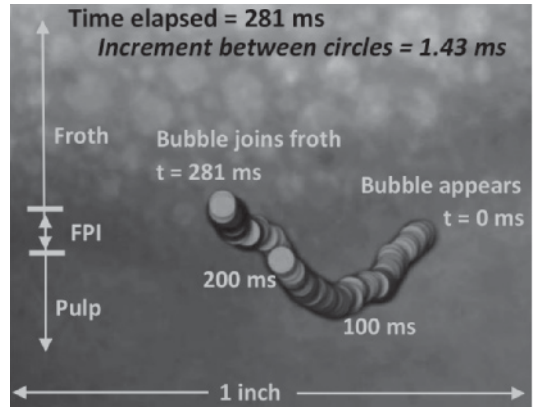

Figure 1 — Bubble movement in FPI tracked across 197 frames.

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