Contribution ID: **5** Type: **Oral presentation**

Industrial Application of OPM: Flow Metering

Friday 8 August 2025 15:40 (20 minutes)

We present a noninvasive flow metering technique that employs optically pumped magnetometers (OPMs) for measuring fluid flow velocities through a novel magnetic-marking approach. The method utilizes polarized hydrogen nuclei within the fluid, which are polarized with a permanent magnet. Radio frequency (RF) pulses are applied to the fluid to create local magnetic marks in the otherwise magnetized fluid. These marks serve as time stamps to enable a time-of-flight measurement, facilitating accurate flow velocity determination without the use of tracers. The OPMs, operating in nano Tesla residual fields, can detect induced magnetic signals as low as 10 pT or less.

A primary focus of this work is the impact of flow profiles on the magnetization distribution within the fluid. Our work focuses on how the radial distribution of flow velocities influences the effectiveness of RF pulsing and the resultant magnetic signals. We have simulated the magnetization distribution in a flowing medium, revealing that varying flow velocities lead to different retention times in the RF field, which in turn affects the magnetization state and the magnetic signal detected by the OPM. The findings demonstrate that the flow profile significantly impacts the quality and characteristics of the magnetic mark in the fluid, paving the way for optimizing flow metering systems based on OPM technology. This work highlights the significant potential of OPMs in advancing an industrial application case such as noninvasive flow measurement techniques.

Authors: SCHMIEDER, Leonhard (Fraunhofer IPM); KOSS, Peter (Fraunhofer IPM)

Presenter: KOSS, Peter (Fraunhofer IPM)

Session Classification: OPM Applications III