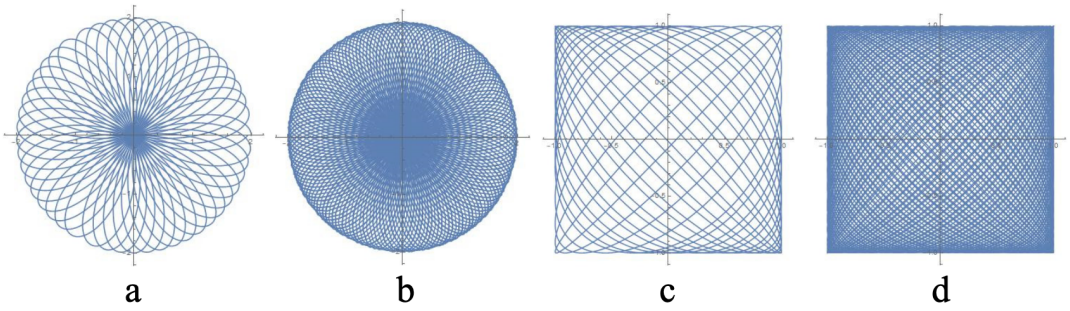
Docket #: S20-316

Doubly Resonant Rose Scanning

Stanford researchers have developed a scanning mirror and method for Rhodonea (Rose) scanning patterns, which are superior to Lissajous patterns for almost all imaging and ranging applications. The scanning mirror is doubly resonant on each of its two rotation axes, which makes Rose scanning possible. (Figure 1) The scanning element oversamples the center by passing through the center, or close to it, twice in every cycle, and thereby rapidly defines the center of the Field of View, which is critical in dynamic imaging modalities like LiDAR. The invention also supports one dimensional scanning, where it oversamples the center of the scan, as opposed to harmonic scans (1D Lissajous) that oversample on the edges of the scans. Fast and evenly filled FOV via Rose scanning is particularly valuable for LiDAR, self-driving cars, artificial reality, computer enhanced reality, computer gaming, and robotics.



Comparison of Rose and Lissajous curves. (a) 16 full loops of Rose curve (b) 80 loops of the same Rose curve as in a. (c) 16 full loops of Lissajous curve. (d) 80 loops of the same curve as in c. Images courtesy of Jennifer Solgaard and Olav Solgaard.

Stage of Development – Proof of Concept

The scanning mirror and method for Rhodonea scanning has been demonstrated via an experimental setup. Next steps are to manufacture a MEMS scanning element and test with LiDAR imaging.

Applications

- Laser scanning used in high-speed, dynamic applications like:
  - LIDAR (especially self-driving vehicles and under water exploration)
  - Robotics
  - Augmented and virtual reality, head mounted displays, gaming
  - Microscopy, spectroscopy, imaging, ranging
  - Laser machining and marking
  - Data acquisition (AI)

Advantages

- Faster and more evenly fills Field of View
- Robust, scalable, and low cost
- Circular FOV better match to commercial optics
- Oversamples center of FOV, which is particularly advantageous for dynamic imaging modalities like LiDAR
- Support one dimensional scanning (oversamples center of scan)

Patents

- Published Application: 20230266581
- Issued: 12,554,125 (USA)

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