Pixie Dust: Graphics Generated by Levitated and Animated Objects in Computational Acoustic-Potential Field

Yoichi Ochiai* Takayuki Hoshi Jun Rekimoto

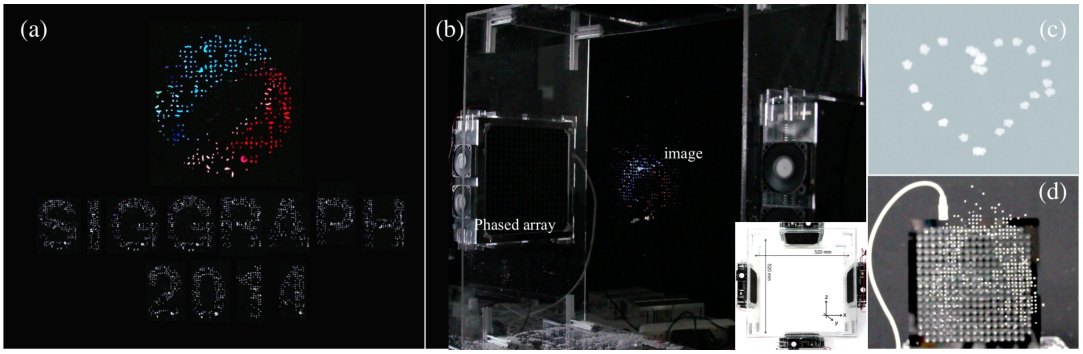

Figure 1: *Application images of Pixie Dust, levitated and manipulated objects in graphic metaphors. (a) Floating screen with projection (SIGGRAPH logo). (b) Acoustic Potential Field Generator overview. (c) Physical vector graphics (heart). (d) Physical raster graphics (A).*

1 Introduction

In this study, we demonstrate real-world-oriented computer graphics by using and expanding 3D acoustic manipulation [Ochiai et al. 2014]. An acoustic potential field (APF) is generated and controlled in order to levitate and manipulate small objects (Fig. 2 (a)). Compared to magnetic levitation, air jets, and other noncontact levitation technologies, our technology has the following advantages: a wide variety of materials are available; it provides a satisfactory refresh rate; and it has a sufficient spatial resolution. It would contributes to the computer graphics community by making the levitated objects usable in graphic metaphors such as the pixels of raster graphics, moving points of vector graphics, and animation (Fig. 1). We believe that it will open a new field of computer graphics if fabricated models can be actuated by APF.

2 Related Work

There have been several studies on manipulation using ultrasonic waves. Ultra-Tangibles [Marshall et al. 2012] utilized the acoustic radiation pressure of traveling waves from the surrounding ultrasonic-phased arrays. Acoustophoretic transport [Foresti et al. 2013] and lapillus bug [Kono et al. 2013] move the object along a 2D plane with standing waves (Fig. 2 (b)). The extended acoustic manipulation [Ochiai et al. 2014] moves objects in a 3D space with opposite phased arrays. Additionally, an expanded acoustic manipulation is developed in this study.

3 Application

Floating Projection Screen: Figure 1 (a) shows a floating screen with 2D-grid APF suspending small particles in all the nodes. The APF forming this screen has a high refresh rate and a high spatial resolution. In our current prototype, the maximum control rate of spatial position is 1 kHz, the distance between the particles is 4.25 mm, and 85×85 particles are suspended at the maximum.

Physical Vector Graphics: A vector graphics display (Fig. 1 (c)) is achieved based on persistence of vision by moving particles at high speed. The trajectories are designed as a series of coordinates,

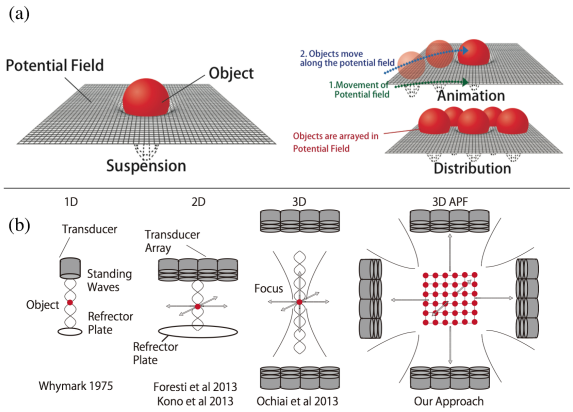

Figure 2: *(a) Concept of computational potential field. (b) Differences in acoustic manipulation approaches.*

which are set up to 1000 points per second. According to the experiments, the maximum speed of movement was 72 cm/s.

Physical Raster Graphics: Figure 1 (d) shows a raster graphics display. First, APF suspends small particles in all the nodes. Next, the system adequately blows off some of the particles and generates a raster image. This process is operated by an additional phased array or air jet.

References

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*email: ochyai@me.com, The University of Tokyo

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