doi:10.36849/JDD.8088e

Light and Laser-Imaging Detection and Ranging (LiDAR) in Dermatology: A New Dimension for Digital Healthcare

Justin W. Marson MD,[a] Rebecca M. Chen MD,[a] Mauricio Portillo MD,[a] Laura Kaplan MD,[b] Daniel M. Siegel MD MS[a,b]

[a]Department of Dermatology, SUNY Downstate Health Sciences University, Brooklyn, NY
[b]A New York Harbor Health Care Brooklyn VA Medical Center, Brooklyn, New York

INTRODUCTION

Dermatology has benefited from multiple technological advancements, including total body photography (TBP)[1,2] and teledermatology.[3] These technological leaps were made possible with the introduction of digital photography, especially with the advent of digital single-lens reflex (DSLR), point-and-shoot (PAS) cameras, and eventually smart devices (ie, smartphones, tablets) in dermatology clinics.[4] However, integrating advanced digital tools into the average dermatology office and routine care can be prohibitive as it may require a sizable investment into specialized hardware (eg, specially-mounted cameras)[2] and/or software not readily available, easily accessible, or financially/fiscally attainable to most dermatologists/patients.

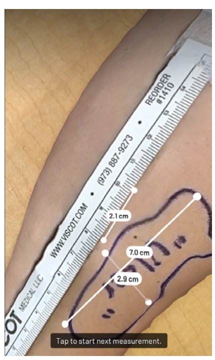
Light and laser-imaging detection and ranging(LiDAR) is a three-dimensional (3D) modeling system that measures the time emitted pulsed infrared light takes to return to a sensor.[5] Based on time (and therefore distance), a virtual high-resolution model with proportional dimensions is generated. As of October 2020, this technology was made available on iPhone 12 Pro and subsequent models (Apple, Inc., Cupertino, CA).[5] With widespread mobile-phone adoption, this technology could materially increase access to teledermatology and TBP for dermatologists and patients alike by providing a method of 3D-modeling parts of a (if not an entire) human body.

The Technique

Here, we demonstrate the use of a free iPhone app, Scaniverse (Niantic, Inc., San Francisco, CA), and 3D models captured on an iPhone 14 Pro Max (iOS 16.4). Models captured can be freely rotated and magnified to better demonstrate lesion(s) color, size, shape, and distribution [eg, patient's left leg evaluated for possible vasculitis (Figure 1)]. The implementation of LiDAR also enables accurate measurements of 3D models, demonstrated by using an in-frame ruler for reference against an "ulcer" on the author's (JWM) forearm (Figure 2A and 2B). These tools could be used to grossly follow nevi between scans and (potentially remotely) measure and triangulate new/concerning/suspicious pigmented lesions. Similar applications can be used as an adjunct for pre-surgical evaluation. Benign (eg, hypertrophic scar on the author's [JWM] left posterior shoulder in Figure 3) and malignant lesions can be identified via LiDAR and, when combined with traditional triangulation to anatomic or persistent cutaneous landmarks (eg, hypertrophic scars, acquired nevi; Figure 4) can theoretically provide a more wholistic pre-operative assessment.

FIGURE 1. Three-dimensional scan using LiDAR of the left lower leg of a patient being evaluated for palpable purpura. After capture, the scan can be manipulated in three-dimensional space and magnified to better assess individual lesion characteristics as well as distribution. (Link to view/download scan: https://bit.ly/3P6uDng)

FIGURE 2. (A) Three-dimensional scan using LiDAR of a left forearm with an "ulcer". Measurements captured via the scan correlate with reference measurements (ie, in-frame disposable ruler), which can allow for improved lesion assessment and triangulation of new/concerning lesions. (B) The "ulcer" measures 7.0 cm by 2.9 cm using an in-app function, which can be used to objectively assess lesion size and relative location. (Link to view/download scan: bit.ly/47ImNre)



Current LiDAR technology is user-dependent and limited by (micro)movements by both "photographer" and subject that can create aberrancies (eg, duplicated patella in figure/video 1, image blur in figure/video 3) and incomplete scans (eg, "transparent" plantar sole, Figure 1). In the authors' experience, imaging with Scaniverse takes several minutes (proportional to subject size); models are optimized by taking a smooth, complete "panoramic scan" while the subject remains as still as possible (ideally seated and/or resting/braced in one position). The authors have found that a "total-body scan" utilizes approximately 16 Mb of data (comparable to a PowerPoint slide deck with several high-resolution images and animations), which includes background (ie, parts of the room behind the subject) that can be cropped out (Figures 1-4). While these scans do allow for some level of magnification, suspicious pigmented lesions on LiDAR models should still be evaluated dermoscopically for complete assessment. Additionally, while scanned models may theoretically be shared via HIPAA-compliant platforms, to the authors' knowledge, HIPAA-compliant LiDAR mobile apps are not (yet) commercially available.

FIGURE 3. A three-dimensional scan using LiDAR of the trunk demonstrating triangulation of a hypertrophic scar on the subject's left posterior shoulder. (Link to scan available at: https://scaniverse.com/scan/4ljg6fvwg2ck6vvs)

FIGURE 4. A cropped LiDAR scan of a portion of the left upper back of the model shown in Figure 3, illustrating further detail of cutaneous findings, including acquired nevi, hypertrophic scars, and folliculitis. (Link to download scan: https://bit.ly/44i5PNj)

Practice Implications

Prior studies have shown that digitized TBP may improve access to skin cancer screening and dermatologic care, especially among high-risk patients and during times/locations with limited clinic availability (eg, COVID-19).[1-3] LiDAR's introduction to mobile phones has democratized 3D modeling by making it available for a majority of the population. Of note, while initially released on iPhone 12 Pro, Scaniverse was functional/backwards compatible with an iPhone SE 2020 (iOS 16.4).

LiDAR is a multifaceted tool that has not yet been widely utilized in medicine, let alone dermatology. Incorporation of LiDAR into dermatologic care could facilitate all forms of (asynchronous) teledermatology by improving the quality and capability of remote evaluations and empowering dermatologists and patients by simplifying and democratizing the TBP process. Future studies should investigate the use of LiDAR in multiple dermatology domains (eg, TBP, asynchronous teledermatology, pre/post-cosmetic procedures, pre-operative surgical site assessment, etc.) in various clinical settings/practices (eg, academia, private, multispecialty, and across dermatology subspecialties) with a focus on cost-effectiveness, patient outcomes, and healthcare access.

DISCLOSURES

JWM serves as Chief Clinical Advisor for Berman Medical. DMS serves as Chief Medical Advisor for Berman Medical. RMC, MP, and LK have no relevant disclosures or conflicts of interest.

REFERENCES

1. Marek AJ, Chu EY, Ming ME, et al. Piloting the use of smartphones, reminders, and accountability partners to promote skin self-examinations in patients with total body photography: A randomized controlled trial. *Am J Clin Dermatol.* 2018;19(5):779-785. doi:10.1007/s40257-018-0372-7
2. Drugge ED, Sarac RM, Fay P, et al. Semi-automated total body photography supports robust delivery of skin cancer monitoring services during the SARS-COV2/COVID-19 pandemic. *Dermatol Online J.* 2021;27(4)
3. Marson J, Ahmad M, Litchman G, et al. Characteristic distinctions between pre-/post-COVID-19 teledermatology adoptees: A cross-sectional United States-based analysis and the implications for dermatologic healthcare equity. *J Drugs Dermatol.* Jan 01 2023;22(1):101-104. doi:10.36849/JDD.7169
4. Chilukuri S, Bhatia A. Practical digital photography in the dermatology office. *Semin Cutan Med Surg.* 2008;27(1):83-5. doi:10.1016/j.sder.2008.01.004
5. Bhandarkar AR, Bhandarkar S, Jarrah RM, et al. Smartphone-based light detection and ranging for remote patient evaluation and monitoring. *Cureus.* 2021;13(8):e16886. doi:10.7759/cureus.16886

AUTHOR CORRESPONDENCE

Justin W. Marson MD

E-mail:................…........................ justin.w.marson@gmail.com