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Melanoma surveillance by multimode, hyperspectral dermoscopy and self-imaging using smartphone in high-risk patients



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Melanoma, the fastest growing cancer worldwide, kills more than one person every hour in the United States and costs more than \$2.4 billion per year. Determining the depth and distribution of the dermal melanin noninvasively will help dermatologists to discriminate normal nevi versus melanoma. We developed a multimode dermoscopy system that combines polarization (cross and parallel), autofluorescence and hyperspectral (400-800 nm) imaging to noninvasively quantify and map in 3D, in vivo distribution of melanin, collagen and hemoglobin oxygenation in pigmented skin lesions. Hemoglobin and melanin spectra have significant overlap and systems that do not take this into account over/under estimate hemoglobin values (by a factor of up to 3) especially when analyzing nevi with high melanin concentration. Our molecular imaging approach can disentangle the hemoglobin and melanin absorptions leading to much more accurate hemoglobin measurement, independent of melanin absorption. By quantifying melanin concentration in pigmented areas, we can also remove the effect of melanin absorption from autofluorescence emission mainly from deeper collagen. We have also translated the knowledge and algorithms from our multimode hyperspectral image processing to improve detection and analysis using smartphone-based images by developing an optical attachment that provides wavelength and polarization conditioning. Image segmentation and analysis functions from the smartphone attachment automatically quantifies and reports biological features of nevi used in standard melanoma heuristics (ABCDE, and seven-point checklist) to a receiving dermatologist. We present molecular distribution maps as well as corresponding melanoma feature checklists derived from image analysis of twenty subjects with pigmented lesion. All patients were recruited as part of an ongoing IRB-approved study at the University of California Irvine. The resulting enhanced images will be employed to extract automatic quantification of melanoma checklist features that dermatologists can view online. By mapping melanin distribution in 3D we are able to estimate Breslow thickness in lesions of interest noninvasively. This could provide a new and valuable diagnostic tool in the detection and clinical management of melanoma.

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