

SPECKLE REDUCTION IN OCT USING MODE AVERAGING

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Background and Objectives: Speckle noise in OCT images originates in the high spatial coherence that allows interference between light backscattered from the tissue specimen. Reported speckle reduction techniques rely on averaging independent intensity images of the speckle field. Recently, we completed an experiment to test speckle reduction by averaging independent intensity images formed by incoherent spatial modes emitted from a broadband light source.

Study Design/Materials and Methods: Broadband light coupled into a multimode optical fiber produces a number of spatial modes that propagate along the waveguide at distinct velocities. After the spatial modes propagate a sufficient length, modes become mutually incoherent. When the multimode fiber is placed in the source path of a Michelson interferometer, each spatial mode produces an intensity image of an independent speckle field.

Results and Conclusions: To illustrate speckle averaging using independent spatial modes, we recorded low-coherence interferograms of a scattering metallic surface using single mode and multimode source fiber. The interferogram recorded using a single mode source fiber is indicative of that observed by conventional OCT. Speckle noise in the interferogram recorded using the multimode source fiber is substantially reduced compared to the single mode case. Design constraints in applying mode averaging for speckle reduction is discussed.

COLLAGEN BIREFRINGENCE IN SKIN SAMPLES FOLLOWING LOW-INTENSITY POLARIZED LASER RADIATION

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Background and Objectives: Recent work by our group indicates semi quantitatively the importance of the relative direction of the laser polarization in wound healing process. This study quantifies the collagen fibers organization in skin samples following low-intensity polarized visible laser therapy.

Study Design/Materials and Methods: Three burns were created on the back of rats. Lesion "L₁" was irradiated by He-Ne

laser, D = 1.0 J/cm², with linear polarization parallel to the spinal column of the rat. On the lesion "L₂," the laser polarization was aligned perpendicularly. Lesion "C" was control. The animals were irradiated on days 3, 7, 10, and 14 post-wounding and sacrificed on day 17 after lesion creation.

Results: Significance was accepted at $P < 0.01$ by using Student *t*-test. Analysis showed that the healing of irradiated wounds was faster than the non-irradiated wounds. Moreover, it was observed that skin wound repair is dependent on the polarization orientation with respect to a referential axis as the animal's spinal column: "L₁" was completely healed after 17 days with collagen fibers more organized, because so higher collagen optical retardation, so higher the collagen birefringence and so higher its organization in connective tissue.

Conclusions: These results indicate that the relative direction of the laser polarization plays an important role on the wound process when visible red laser is used.

MEASUREMENT OF THERMO-REFRACTIVE AND THERMO-ELASTIC CHANGES IN A TISSUE PHANTOM USING DIFFERENTIAL PHASE OPTICAL COHERENCE TOMOGRAPHY

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Background and Objectives: High sensitivity of differential phase (DP)-optical coherence tomography (OCT) allows measurement of nanometer scale changes in optical pathlength in tissue in response to external stimulate. Transient change in DP in response to absorption of pulsed laser radiation is due to thermo-elastic (β) and thermo-refractive (dn/dT) effects. We report experiments to measure β and dn/dT in a tissue phantom in response to pulsed laser excitation.

Study Design/Materials and Methods: In response to pulsed laser excitation (585 nm), DP change in a tissue phantom containing a dye solution is measured using a dual-channel (DP-OCT). Transient change in phase difference between interference fringes in the two channels of the DP-OCT are used to investigate the thermo-elastic and thermo-refractive changes in the tissue phantom.

Results: Combined effect of thermo-elastic and thermo-refractive contributions is $n\beta + dn/dT = 1.831 \times 10^{-4} (K^{-1})$. The measured value is 1.18 times higher than change due to a pure thermo-refractive effect ($dn/dT = -1.548 \times 10^{-4}$). Error in measured values is compared to data for water compiled by NIST. $n\beta + dn/dT = 1.679 \times 10^{-4}$ and $dn/dT = -1.056 \times 10^{-4}$. Measured values of β and dn/dT in a tissue phantom are close to published data for water.

Conclusions: DP-OCT is applied to measure the DP change in a tissue phantom in response to pulsed laser excitation. Measured phase change due to thermo-elastic and thermo-refractive effects are differentiated and measured.

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