noise onto the *op* amplitude at 42 Hz. The influence was small, however, since the modulation frequency was approximately an order of magnitude faster than the slow modulation due to Brownian movement.

Precision of DWP-OCT $SaO_2$ measurements can be improved by: 1) decreasing relative uncertainty of laser excitation intensity ($\delta I$) incident on the sample; 2) decreasing relative error in optical pathlength ($\delta[\Delta op]$) by utilizing a higher modulation frequency of laser excitation thus detuning from low-frequency phase drift artifacts; 3) increasing number of laser excitation wavelengths to more than two; or 4) increasing number of *op* measurements in the vessel wall at each laser excitation wavelength.

In conclusion, we introduced DWP-OCT to measure $SaO_2$ levels in a blood vessel phantom. The approach was demonstrated in a vessel phantom containing stationary blood and provides good agreement with an established reference technique. Compared to existing techniques, DWP-OCT provides some important features for $SaO_2$ measurement including depth-resolved measurements and capability to measure $SaO_2$ levels in discrete vessels. DWP-OCT is based on detection of optical pathlength (*op*) changes in response to absorption of excitation light and is therefore free from high variation of depth-resolved scattering-based spectral OCT approaches [15,19]. Moreover, scattering properties of blood do not influence the accuracy of DWP-OCT $SaO_2$ measurements and spectral- and depth-resolution provided by DWP-OCT are not compromised. Moreover, the model equation (Eq. (6) developed to determine DWP-OCT $SaO_2$ levels avoids computationally intensive Monte Carlo simulations utilized in previous approaches. High sensitivity of DWP-OCT to measure optical pathlength (*op*) changes in blood allows application of relatively low-level laser excitation intensities. The demonstrated results suggest that further investigation of DWP-OCT in pre-clinical models is warranted.

**Acknowledgments**

This research was partially supported by NIH KL2 training grants (parent grants UL1RR025767 and KL2RR025766), San Antonio Area Foundation grant 130977 to RVK, Department of Veterans Affairs (VA MERIT Award) to T. Q. Duong and NIH (R01 EY018855 and R01 EY014211) to T. Q. Duong.

#139483 - $15.00 USD Received 9 Dec 2010; revised 24 Jan 2011; accepted 29 Jan 2011; published 3 Feb 2011