Optimisation of movement detection and artifact removal during laser speckle contrast imaging

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**Introduction**
Laser speckle contrast imaging (LSCI) allows an easy non-contact monitoring of the cutaneous blood flow (CBF), but is highly sensitive to movement artifacts (ARTm). Subtraction of a signal recorded on an adhesive opaque surface (AOS) close to the area of interest was reported as a mean of reducing noise from the raw skin LSCI (LSCIsk) signal, provided an individual calibration was performed. Assuming that AOS = a · CBF + b · ARTm, an ideal patch should completely block the light reflection due to CBF and thus be insensitive to skin blood flow changes (“a” ~ 0), while keeping a reflection signal amplitude similar to the one from the skin in case of artifact (“b” ~ 1). This ideal AOS has not been determined and may discriminate flow from movements during LSCI recordings.

**Materials and methods**
We tested different AOSs to determine their “a” and “b” parameters in 35 and 34 healthy volunteers, respectively. The AOS surface providing results as close as possible to an ideal AOS, was used for a point-by-point de-noising of post occlusive reactive hyperemia (PORH) on two different days in 15 new subjects. Correlation of raw, smoothed (average smoothing over 1 s intervals) and denoised signals was tested through a cross-correlation analysis of the two POHR tests.

**Results**
The optimal “a” and “b” values were obtained with a homemade bilayer adhesive patch (a = 0.06 ± 0.05 and b = 1.03 ± 0.17) whereas other tested AOS had “a” values ranging from 0.05 to 0.23 and “b” values ranging from 2.69 to 3.82. Using the bilayer adhesive patch the cross-correlation between the two tests of POHR increased from 0.330 ± 0.128 for raw, to 0.461 ± 0.168 for smoothed and 0.649 ± 0.128 for denoised signals respectively (p < 0.05 from raw coefficients).

**Conclusion**
The home-made bilayer adhesive seems the optimal AOS for the removal of ARTm from the LSCIsk signal while respecting CBF signal. This specific AOS allows for an efficient de-noising of LSCI measurements without the need for individual calibration.

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