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# NUMERICAL PROTOTYPING OF MICROFLUIDIC SYSTEMS WITH AUTONOMOUS TEMPERATURE CONTROL

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**Abstract.** *Lab-on-a-chip* devices are currently offering solutions in clinical diagnostics such as glucose determinations or blood electrolytes among others. However, the present needs of health system mainly involve the detection of complex pathogens such as viruses e.g. SARS-CoV-2, HIV or DENV. For these, the target analyte is a fraction (or fractions) of nucleic acids (NA), and consequently, those fractions of NA need to be amplified in order to produce detectable signals. There are several methods for NA amplification such as PCR or LAMP, among many others, with the common feature that all of them require a precise control of temperature in order to achieve an acceptable efficiency. In order to implement effective strategies for thermal control in *lab-on-a-chip*-based AN amplification, constant temperature must be kept within a narrow tolerance (usually $\pm 1$°C). In order to achieve these conditions, thermal baths with closed loops controls or similar strategies are currently used, which sensible conspires with the desirable portability of *lab-on-a-chip* devices. Alternatively, in order to keep temperature stable, it can be exploited the fact that phase changes develop at constant temperature. Depending on the AN amplification technology employed, the required temperatures range from 40 to 90°C. Consequently synthetic paraffins are excellent candidates for this application due to their characteristic fusion temperature range, and the possibility of defining their composition in order to obtain a precisely tuned fusion temperature. In this work, we present the development and implementation of numerical prototypes of *lab-on-a-chip* with autonomous temperature control, based on the phase change of paraffins. This particular implementation is based on `chtMultiregionFoam`, a solver included in the OpenFOAM® platform. Equations for incompressible newtonian fluid flow and thermal flow, which includes the modelling of phase change through a source term, were solve under a weakly coupled scheme. We evaluate different prototype designs in order to demonstrate the capability of the proposed simulation scheme to contribute to the R&D of this technology.