Case studies in X-ray computed tomography surface texture measurement

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Abstract. X-ray computed tomography (XCT) is now capable of achieving lateral resolutions that approach those achievable by optical and contact surface measurement systems [1,2]. As such, XCT has been used in the measurement of internal and difficult-to-access surfaces that are commonly found in additive manufactured (AM) parts [3]. However, the use of XCT for the measurement of surfaces in industries other than AM has been explored to a lesser extent, though interest in doing so has been shown by a number of industrial manufacturers as part of the European AdvanCT project [4]. Particularly, XCT has not been applied to the measurement of surfaces smoother than the typically rough (Sa > 1 µm) surfaces present in AM parts. In this work, we discuss the challenges of XCT surface measurement on injection moulded parts (figure 1a) and medical needles (figure 1b). Measurement data is acquired using XCT systems at the Danish Technological Institute and the University of Nottingham. Characterisation is based on the computation of ISO 25178-2 [5] surface texture parameters. XCT measurement is also compared to optical measurement via coherence scanning interferometry (CSI) [6], using quantitative topography comparison methods based on statistical topography modelling (presented elsewhere [3,7]). The studied surfaces are representative of a wide array of topographic patterns and surface textures, and thus present interesting scenarios for the investigation of XCT surface measurement behaviour and performance. In particular, the results show how the marginally lower lateral resolution of XCT surface measurement (when compared to optical measurement via CSI) affects both topographic reconstructions and the value of surface texture parameters when the spatial frequencies present on surfaces approach the minimum resolvable frequencies for the XCT systems. The results, therefore, show the ability of XCT to generate surface topography reconstructions as a result of the degree of texture present on the surface. Ultimately, the results presented in this work contribute to understanding the use of XCT surface measurement in a wide range of applications. We would like to acknowledge Novo Nordisk for supplying case studies, and the Danish Technological Institute for providing XCT data.

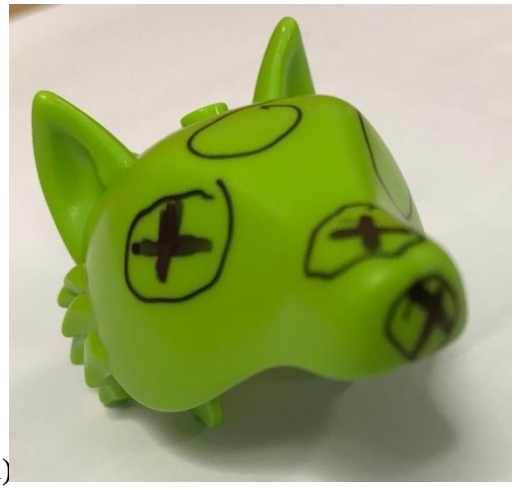
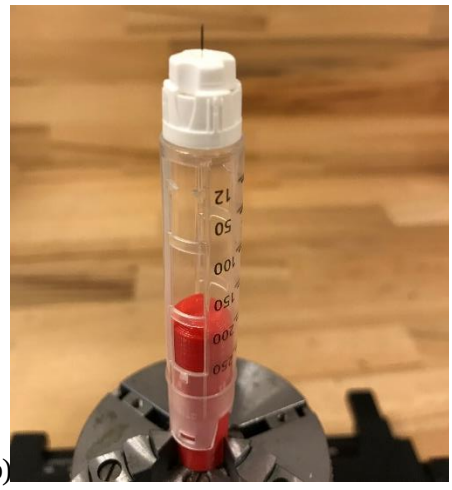
a)  b) 

Figure 1. Example industrial parts to be measured during this case study: a) animal mask; b) insulin needle, courtesy of Novo Nordisk

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