Recently, smart textiles have been developed by integrating smart components onto textiles' surface through various finishing processes such as knife coating or direct coating, transfer coating, inkjet printing. These techniques are well established in textile field and demonstrated some interesting opportunities in terms of functionalization of textile materials; however several of their limitations (cost, complex shape can hardly be designed, viscosity of the conductive materials, long process time, etc.) restrict commercially their use in the domain of smart textiles.

Compared to the traditional textile finishing processes, Fused Deposition Modeling (FDM) is a novel and sustainable three-dimensional (3D) printing technique which allows the printing of conductive tracks, sensors or antennas onto the surface of the textiles with very low waste of materials and fast prototyping option. Besides, with 3D printing technique complex and customized shapes can be obtained anywhere on the textile materials. Despite those advantages, the utilization of 3D printing technology in smart textiles is limited as strong knowledge on both the process and materials needs to be developed.

This thesis provides a technology-driven approach with resource-efficient solutions for the manufacturing of functional textiles. The tensile properties, the deformation under compression, the adhesion and wear (i.e. abrasion) resistances of 3D printed polymer onto textiles were optimized through reliable statistical modeling. Furthermore, the influence of abrasion on the electrical conductivity of the conductive was investigated using monophasic polymers well-commercialized in 3D printing such as poly lactic acid (PLA). The use of PLA as matrix of the conducting polymer composites (CPCs) is not adapted for textile materials applications due its brittle behavior at ambient temperature. Higher flexibility could be achieved by producing biphasic composite polymers using immiscible polymer blends (elastomer/thermoplastic) with selective location of the fillers. Besides, the influence of the extrusion procedures and the percentage of elastomers in the conductive blends on the deformation and the electrical conductivity of the CPCs onto textiles were analyzed. A significant improvement of these properties is confirmed when using biphasic thermoplastic/elastomer blends with selective location of the fillers at the interface or in the thermoplastic phase. The development of conducting and flexible biphasic monofilaments creates new potential opportunities in the domain of functional textiles through 3D printing.

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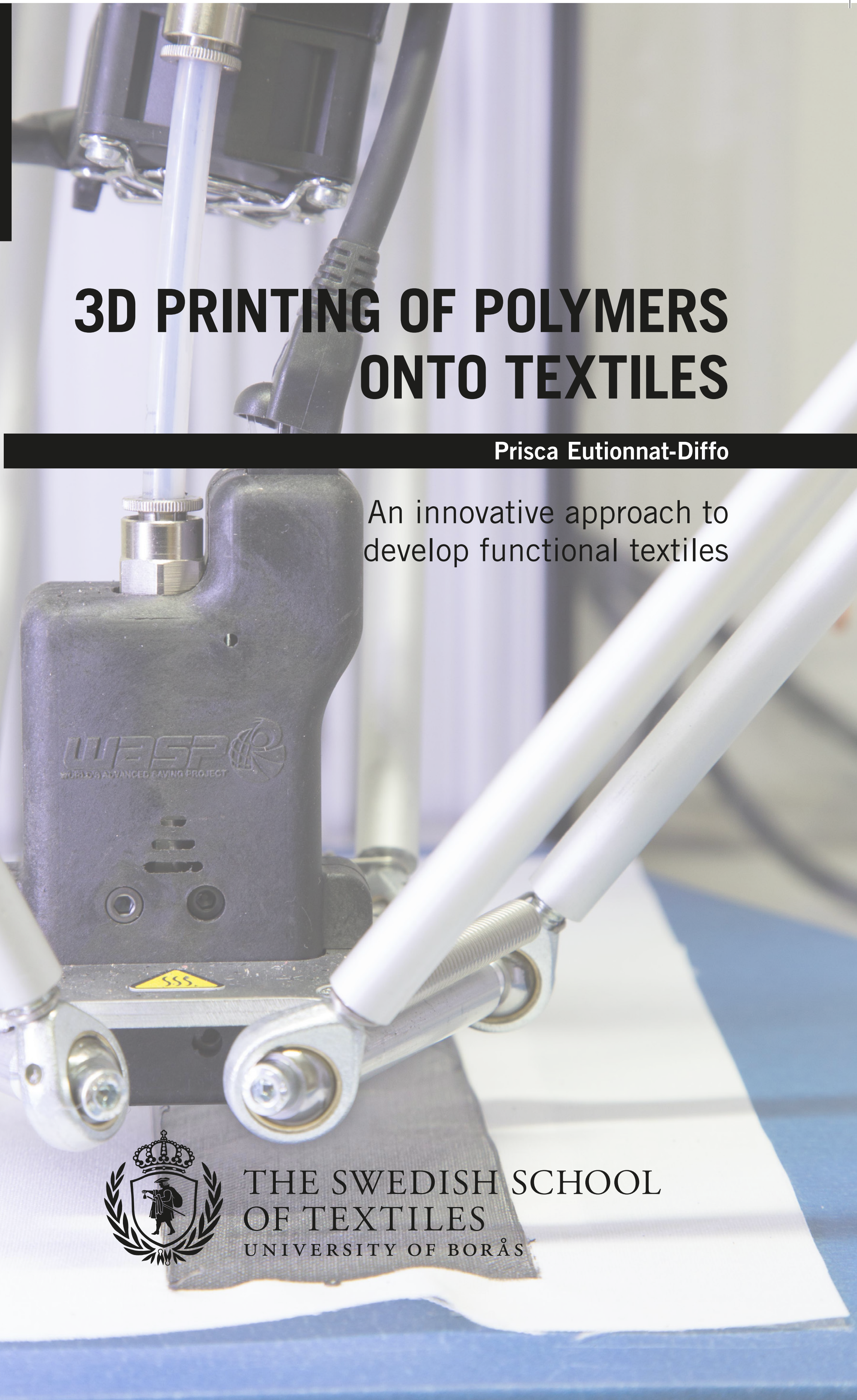

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