# Quality Inspection and Evaluation of Smart or Functional Textile Fabric Surface by Skin Contact Mechanics

## MELKIE GETNET TADESSE

Högskolan i Borås

Avhandling för doktorsexamen inom Textil materialteknik, att läggas fram för offentligt försvar fredagen den 10 maj 2019 kl.10:00 (lokal tid) i styrelserummet vid The Faculty of Textiles-Leather and Industrial Management, Iasi, Rumänien.

Disputationen startar kl. 09:00 svensk tid och kan följas via länk i sal T369, Högskolan i Borås

Seminariet ges på engelska

Opponent: Professor Cristian Vasile DOICIN

# HÖGSKOLAN I BORÅS

# Abstract

The rapid progress in consuming e-textiles has made a huge uprising in the researcher's track on the course of smart and functional textile development. Consumption of functional and smart textiles in the wearable e-textile is fetching extra eye-catching scheme owing to its lightweight property, flexibility, stretchability, and the ability to be integrated into wearable apparel. This platform makes wearable e-textile arena to be more user-friendly, but at the same time, it sets a limit to some of the real desires of the tactile comfort during skin contact. So far, many researchers have attempted to provide the consumers with a real sense of ordinary fabric hand through subjective and objective evaluation techniques. However, few or no attempts have been achieved to evaluate the tactile comfort of functional and smart fabrics.

In this current thesis, we propose for the first time a systematic methodology to study the functional and smart textile fabric's tactile comfort properties through subjective and objective evaluation using skin contact mechanics principle. First, various functional and smart textile fabrics were produced, developed and collected using different state of the art technologies such as 3D printing, coating, inkjet printing, screen printing, incorporation of smart fiber during knitting operation. The samples produced using the above mentioned technologies were thermochromic, conductive, and photochromic type. Then, we investigated the physiological and psychological aspect with regards to the tactile comfort on the basis of visual and blind subjective evaluation for the tactile properties and interpreted utilizing different statistical techniques. Sensory experiments employing a trained panel of experts were carried out to verify the tactile handle. We followed a novel approach to verify the hypothesis obtained from different tactile attributes. From this study, we conclude that it is likely to perceive the tactile comfort properties through visual and blind scenarios.

In order to explore further, objective measurements of tactile properties of the samples were conducted using the Kawabata evaluation system (KES). Low-stress mechanical properties related to the tactile comfort of the fabrics were measured using KES. The KES result confirmed that it is credible to measure the tactile properties using objective evaluation methods to interpret the tactile properties of the samples. Sets of relevant intelligent systems such as fuzzy logic and artificial neural network (ANN) were implemented to interpret and analyze the subjective and objective sensory datasets and to compare the results obtained by both methods.

**Keywords**: tactile comfort; expert; subjective evalaution; objective evalaution; smart fabric; functional fabric; skin contact; KES; sensory evalaution; sensory perception.