

# Hyper Spectral Imaging & The Herlufsholm Special Collection

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## BACKGROUND

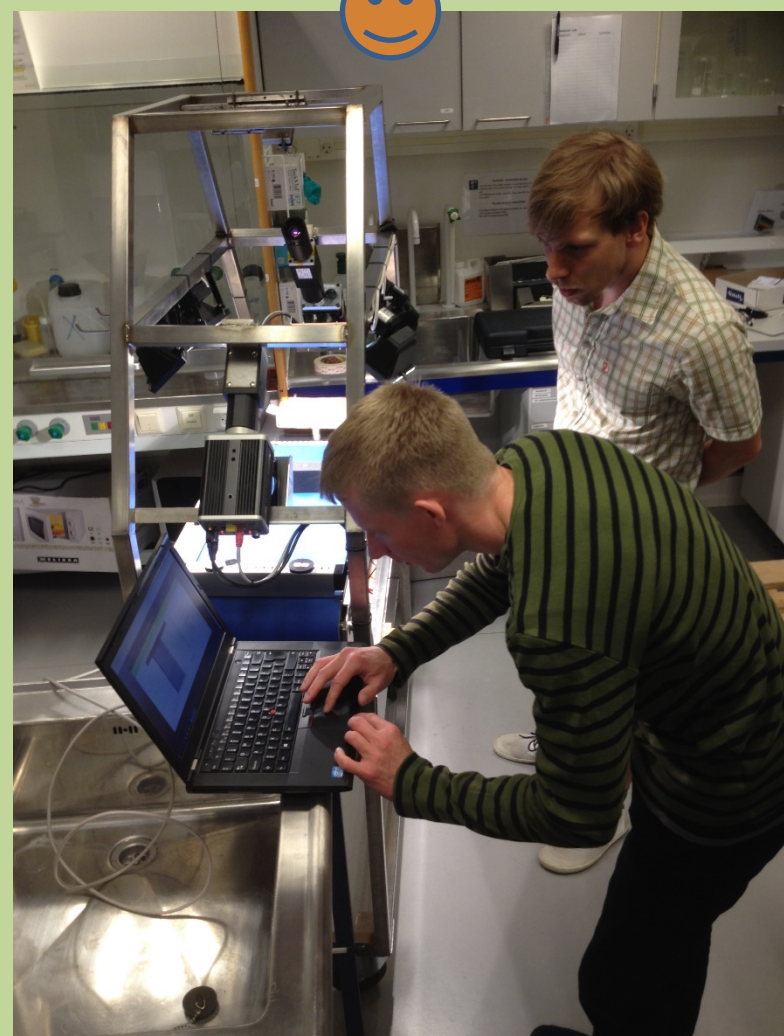
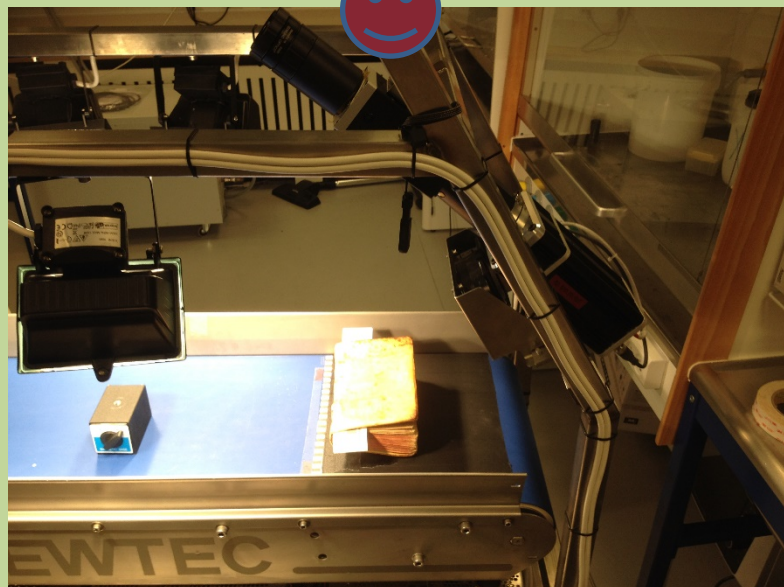
Pieces of rare texts, such as medieval manuscripts, may be found as part of the binding of 16<sup>th</sup> and 17<sup>th</sup> century books. Such pieces are termed “fragments”. Often, these fragments constitute hitherto unknown sources and may provide new information to medievalists, historians, philologists and other academic scholars. At this point, more than 100 fragments have been discovered in the Herlufsholm Special Collection at the University Library of Southern Denmark.

However, many fragments are difficult to read and identify because they are still part of the binding of books. Usually, the identification is obscured by a piece of overlaying paper or a very worn parchment. Subsequently, the university library seeks technologies that in a non-destructive fashion may facilitate a reading and an identification of such fragments.

## PURPOSE AND HYPOTHESIS

The University Library of Southern Denmark was recently contacted by the Danish company Newtec Engineering in Odense who wanted to test their Hyper Spectral Imaging (HSI) technology on a selection of old books containing unreadable texts in their bindings. The company develops weighing, packaging and optical sorting machinery for the food industry.

The hypothesis was that Newtec’s HSI and optical scans in the near infrared spectrum would make it easier to read texts on worn medieval parchments and underneath layers of paper. Therefore, a selection of monographies from the Herlufsholm Special Collection was brought to the company for optical scans. Any new information on the discovered fragments in the bindings would be considered an important breakthrough for the centuries old materials as cultural artefacts. In addition, Newtec would benefit from the tests that would help adjust their core technologies for multiple purposes.

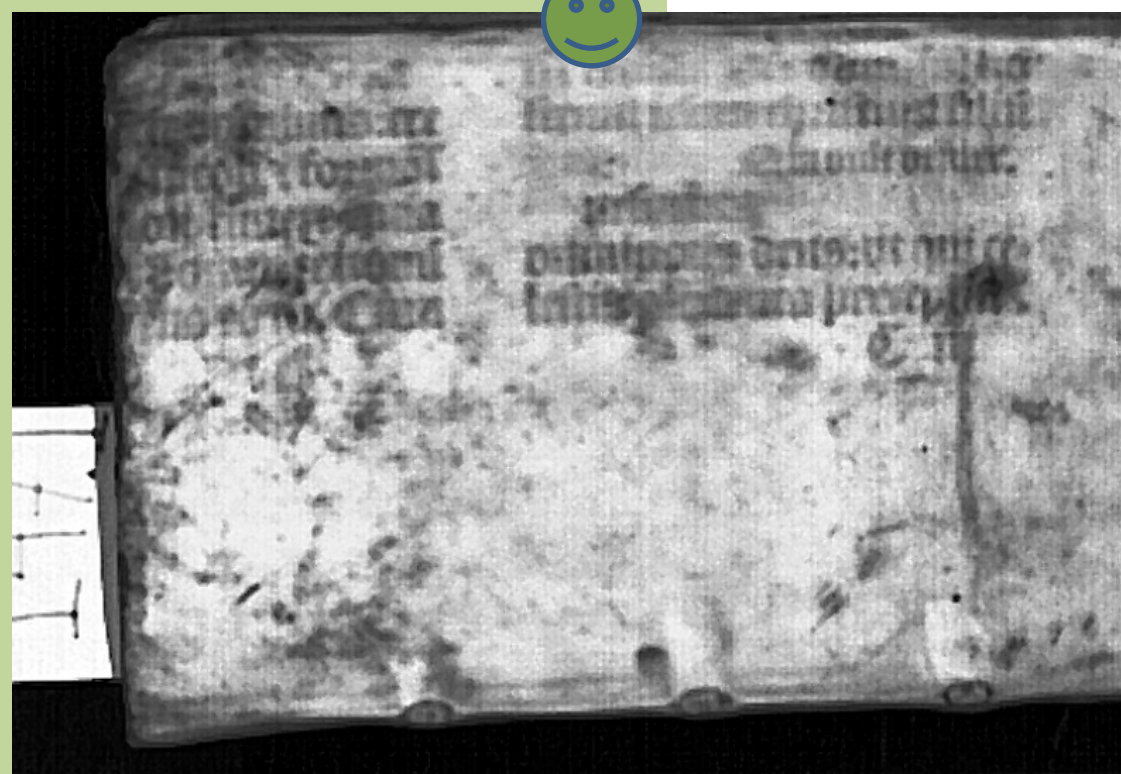
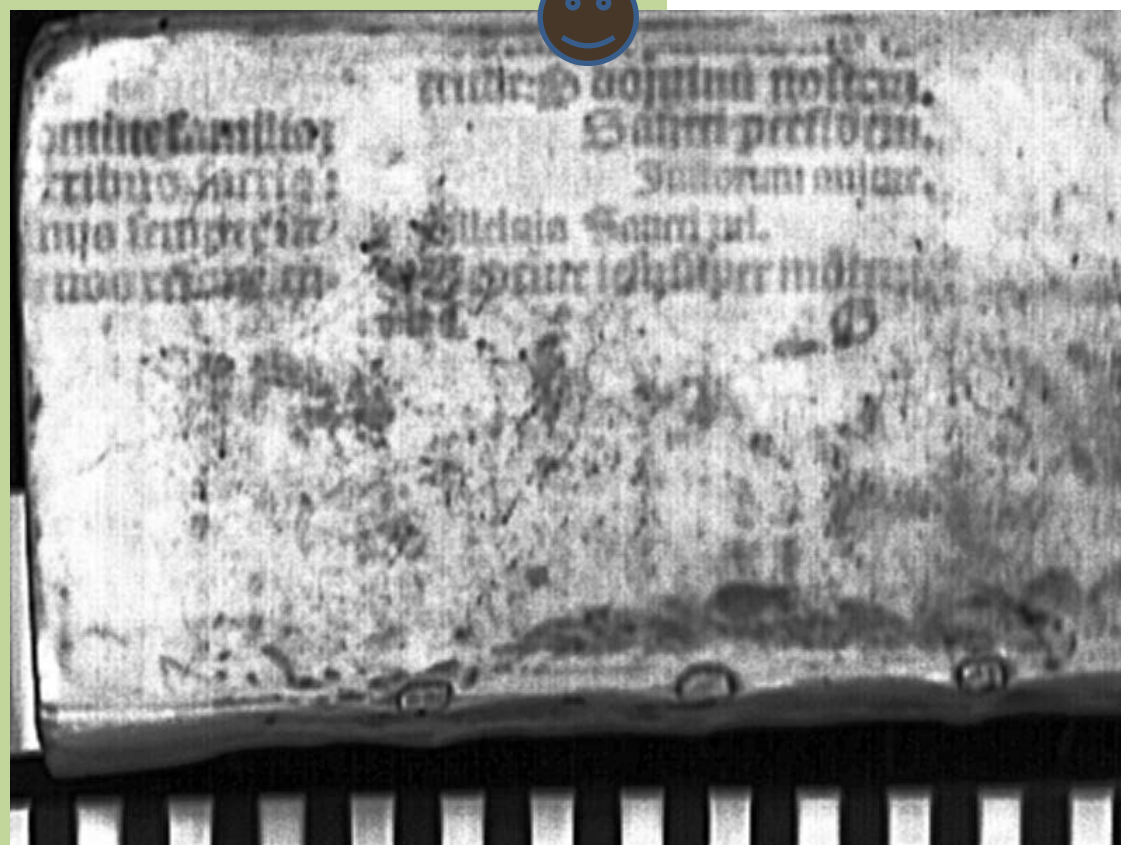


## MATERIALS AND METHODS

Among the books that were taken to the optical scans at Newtec’s was a 1583 Frankfurter edition of *Commentariorum de Religione Christiana Libri quatuor* by Petrus Ramus a.k.a. Pierre de la Ramée (1515-1572).

This particular copy – with the shelf signature Herlufsholm 147.1 – once belonged to the Danish bishop Hans Poulsen Resen (1561-1638).

Now, a 16<sup>th</sup> century bookbinder has used a medieval manuscript parchment piece to form the cover of the copy. However, the medieval text cannot be read in visible light. In the facilities of Newtec Engineering, the book cover was scanned in 2017 using HSI at different wavelengths (420-960 nanometer, with an interval of 2,5 nm) and a spectrograph from Specim (ImSpector V10E) as optics. The HSI experimental setup allows the book to pass on a conveyor belt underneath the cameras and the lighting. The images are transferred to a pc for enhancement. Afterwards, a full text search in Google and in the Cantus Index was used to identify the recovered text passages. Newtec Engineering did not encounter any obstacles during their scan of both sides of the book.



## IMAGES



Scanned front of the cover of Herlufsholm 147.1



Scanned back side of the cover of Herlufsholm 147.1



Hyper Spectral Imaging setup at Newtec



Onscreen adjusting of scan results by Newtec personnel



The book on the conveyor belt (in visible light) for HSI

## RESULTS – SUMMARY IN KEY POINTS

- Making an unreadable text considerably more legible. This has led to the isolation of liturgical Latin phrases like “Sancti per fidem” (Cantus ID: 006814b) as well as “[Quaesumus] omnipotens deus ut qui celestia alimenta percepimus [...]” (used for Postcommunio)
- Enabling further analysis of the text in the scholarly community, within various academic fields, e.g. using data mining. This has enabled hypotheses as to the specific genre – a missal.
- Creating the first digital versions of this text
- Contributing to the ongoing development of multipurpose imaging technology (Newtec)

## CONCLUSIONS

The combination of Hyper Spectral Imaging and Data Mining on the Internet provides a powerful Digital Humanities tool for the identification of medieval manuscript fragments – and of printed fragments as well. The work done at Newtec Engineering clearly documents the technological advantages of the collaboration between Danish industry and a university library: Both parties benefit from the conducted experiments and gain new insights.

Here lies a great potential of recovering important cultural artefacts from oblivion – materials that have been lost and forgotten for centuries, even millennia.

## BIBLIOGRAPHY

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Duivenvoorden et alii (2017). Duivenvoorden, J. R., A. Käyhkö, E. Kwakkel og J. Dik: ”Hidden library: visualizing fragments of medieval manuscripts in early-modern bookbindings with mobile macro-XRF scanner”. *Heritage Science* 5:6.

Kim, Deng & Brown (2011). Kim, Seon Joo; Fanbo Deng & Michael S. Brown: “Visual enhancement of old documents with hyperspectral imaging”. *Pattern Recognition*, Volume 44, Issue 7, 2011: 1461-1469.

## LINKS

Cantus Manuscript Database: <http://cantus.uwaterloo.ca/>

Cantus Index: <http://cantusindex.org/>

