

Background

The Hypo number is a parameter used to determine the extent of delignification that has occurred during chemical or semi-chemical pulping. It is defined as the amount of bleach consumed per gram dried pulp. Currently, the Hypo Number is determined using a labour intensive wet chemistry assay. NIR spectroscopy has shown success in determining the Kappa Number, the more popular measure of the extent of delignification, and the application thereof in the PPI is growing due to ease of use and rapid results. NIR spectroscopy technologies are expensive and more recent miniature spectrometers claim to perform as well as leading brands at a fraction of the cost.

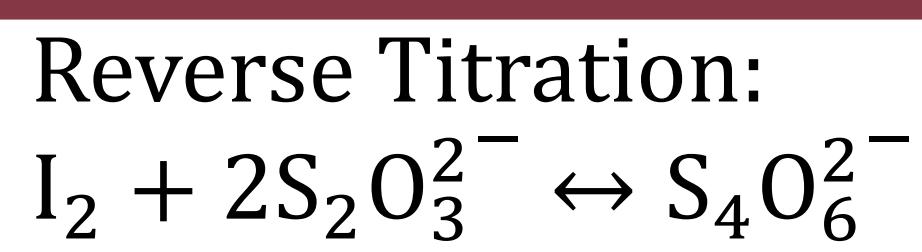
Objectives

- Experimentally determine the Hypo number
- Generate a library of NIR spectra
- Develop a partial least square regression (PLSR) and principal component (PCR) models to predict the Hypo Number
- Compare the LinkSquare to SWIR- 384 in terms of performance, cost and application in the PPI.

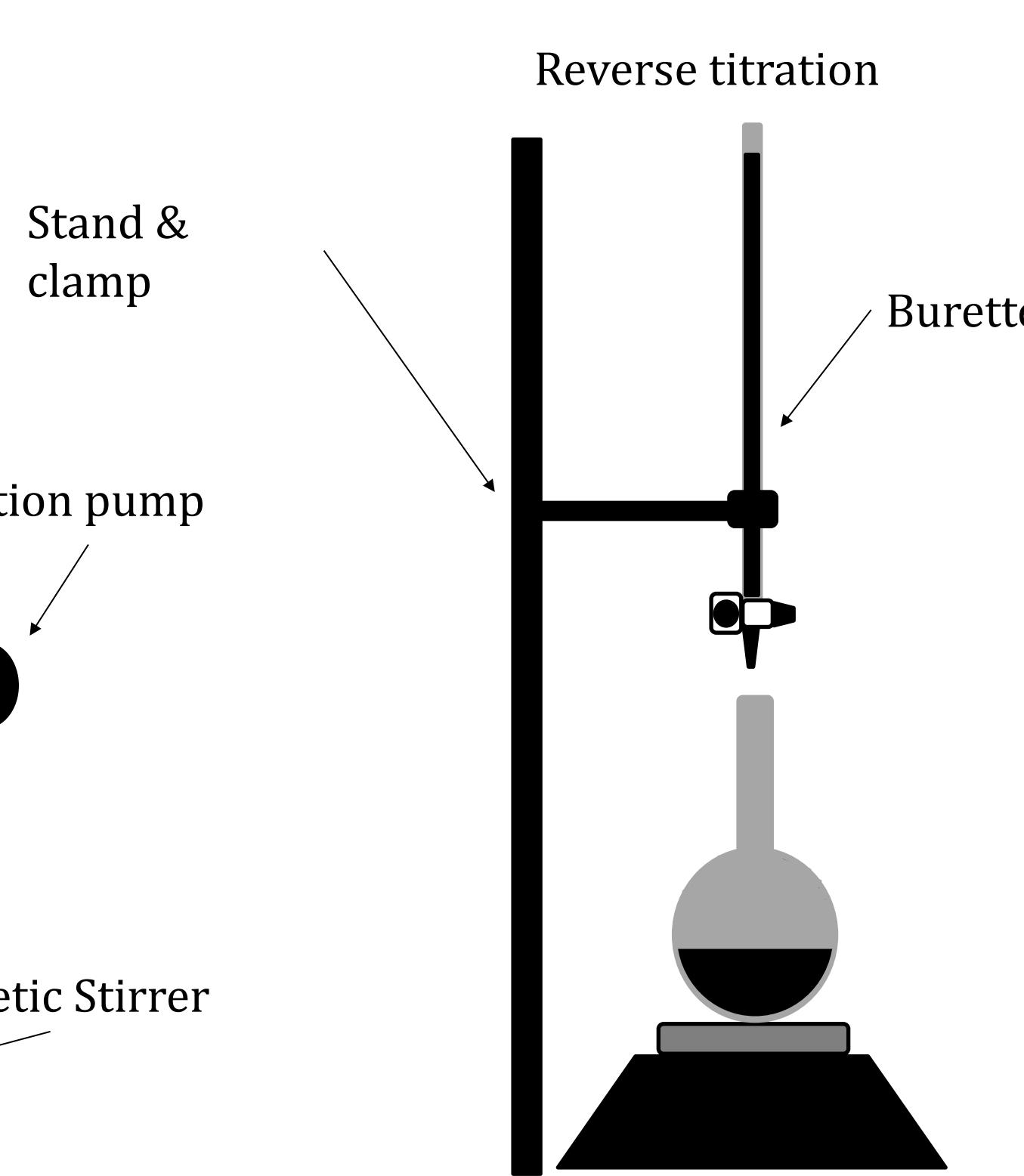
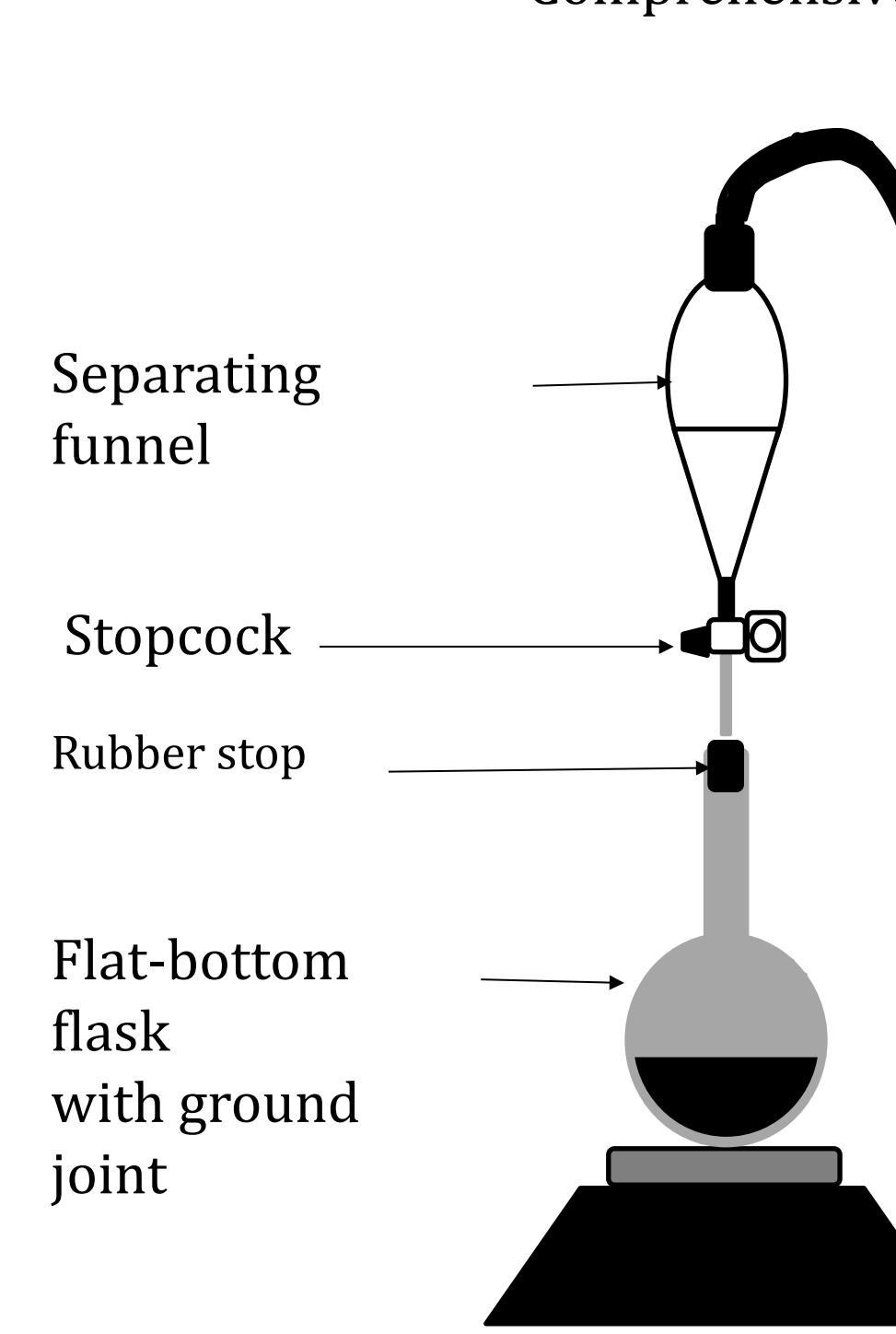
Procedure

Wet chemistry assay

Comprehensive test:

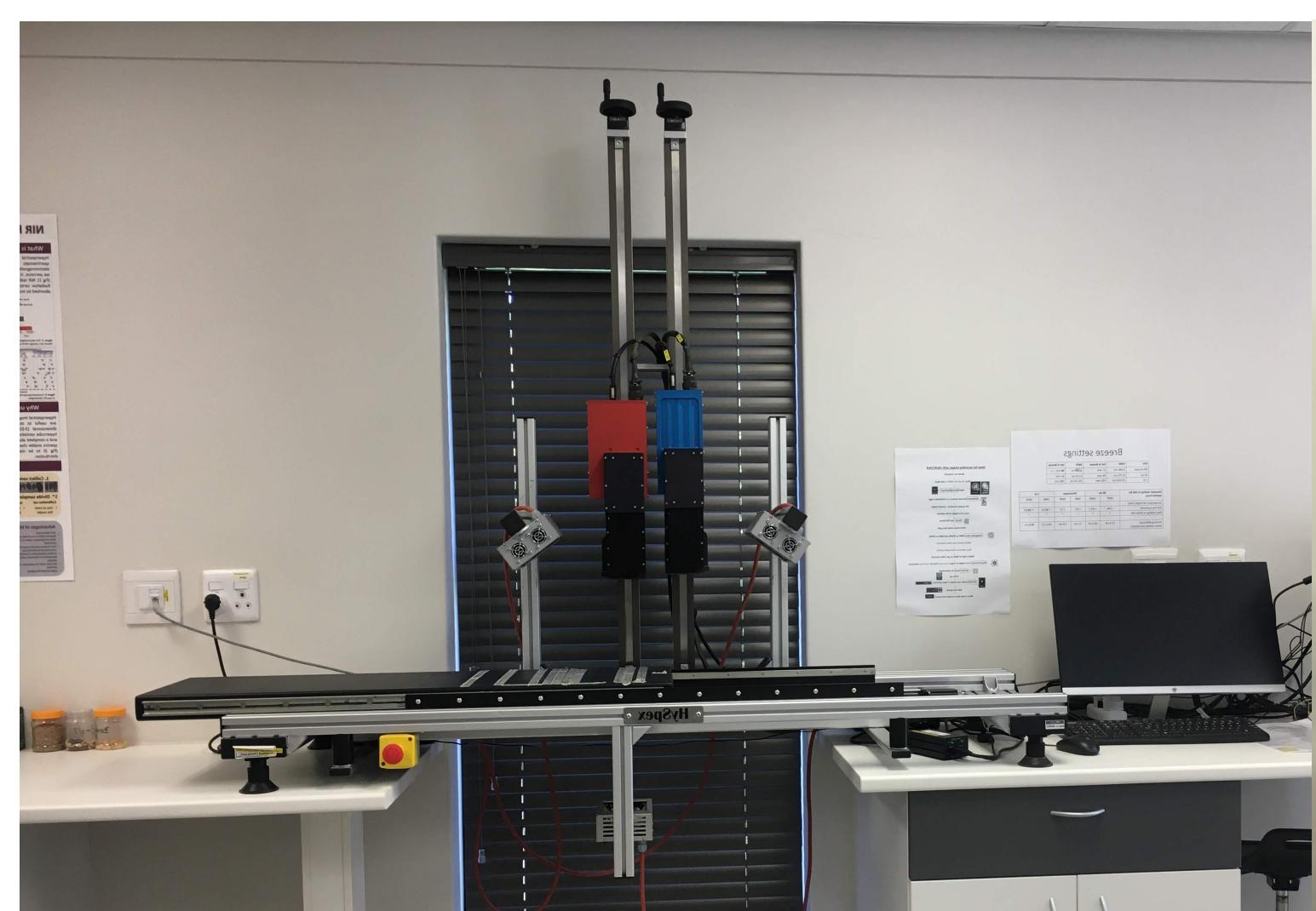


Comprehensive Test



Spectrometers

SWIR-384



LinkSquare

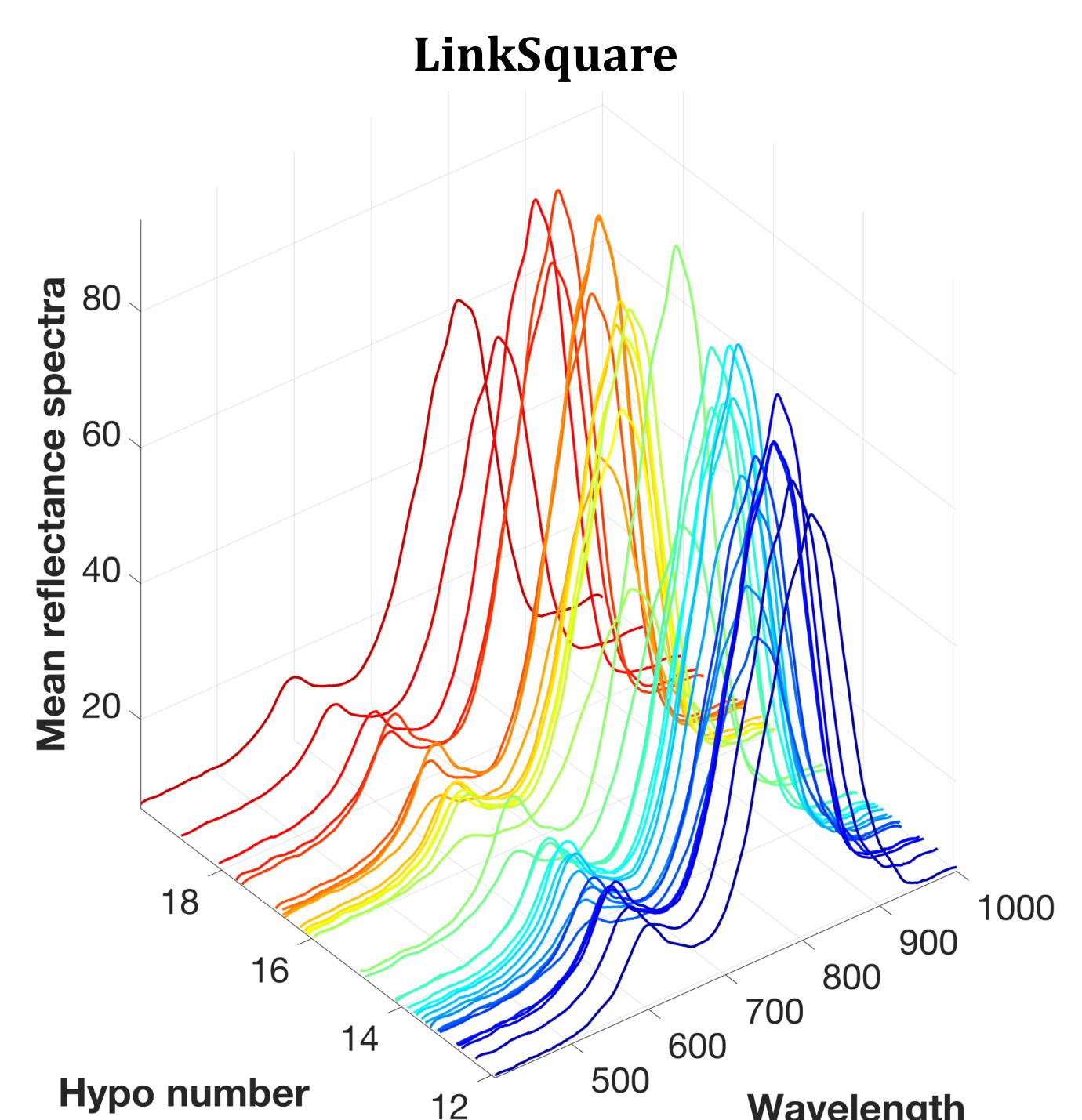
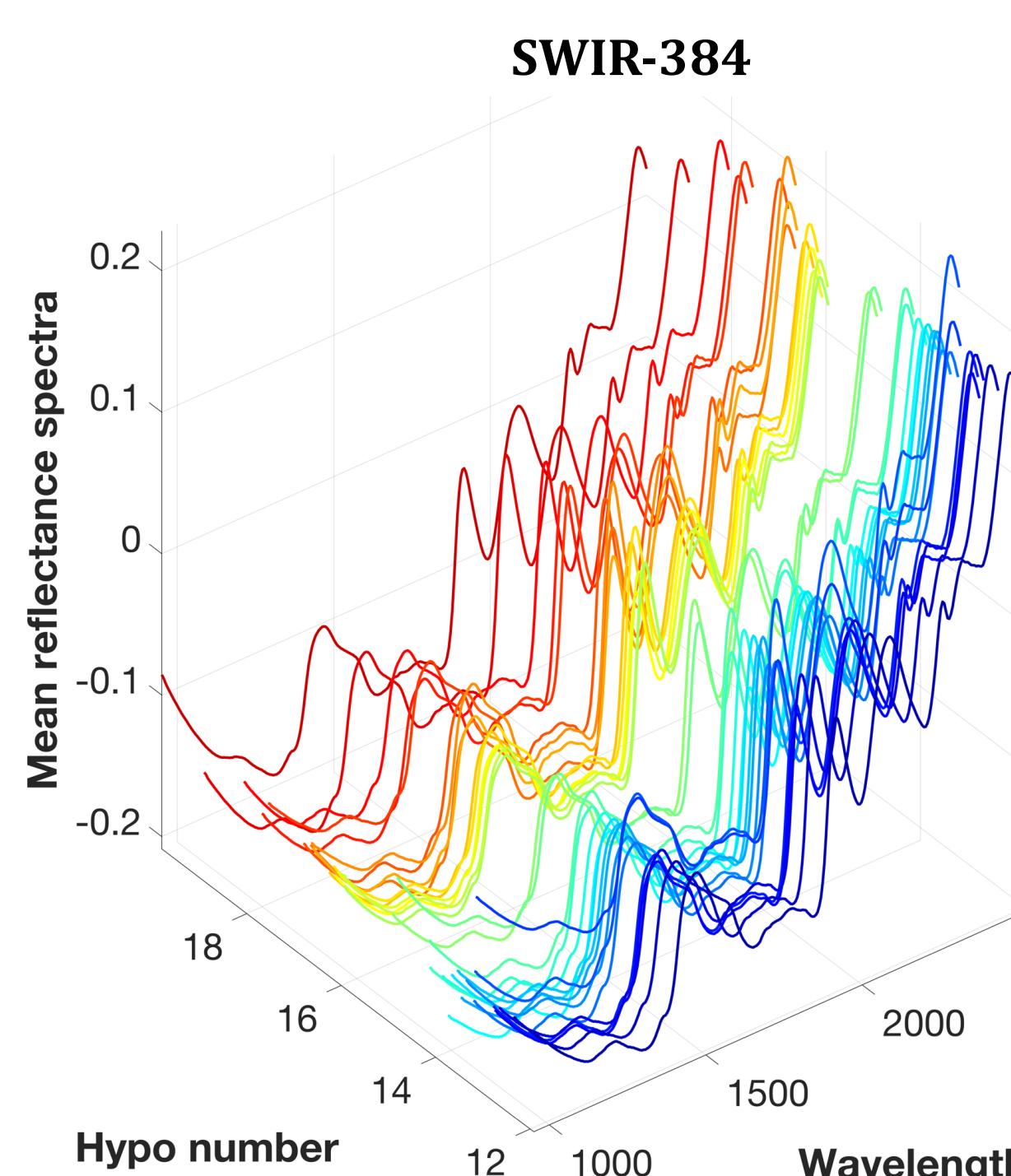


NIR analysis

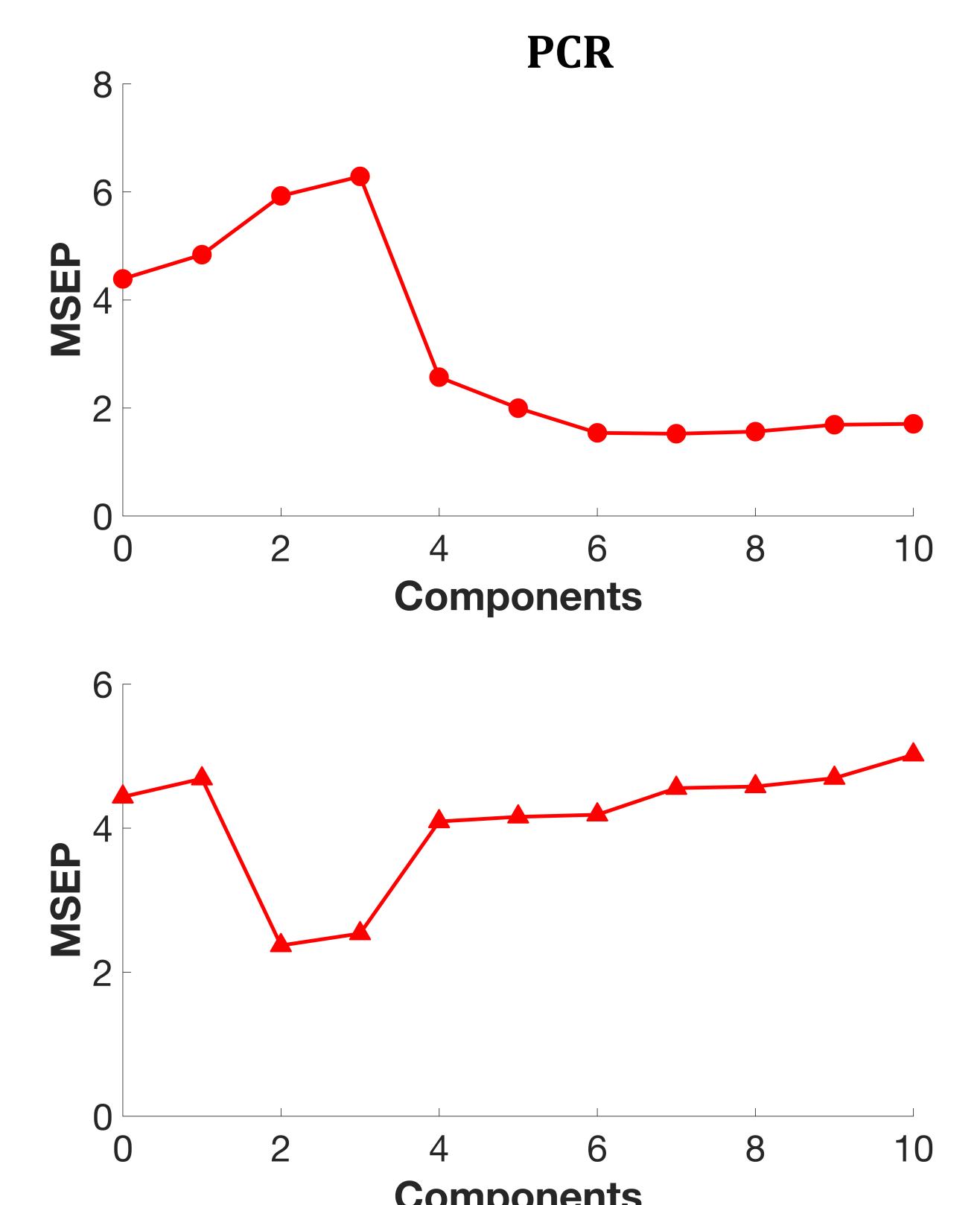
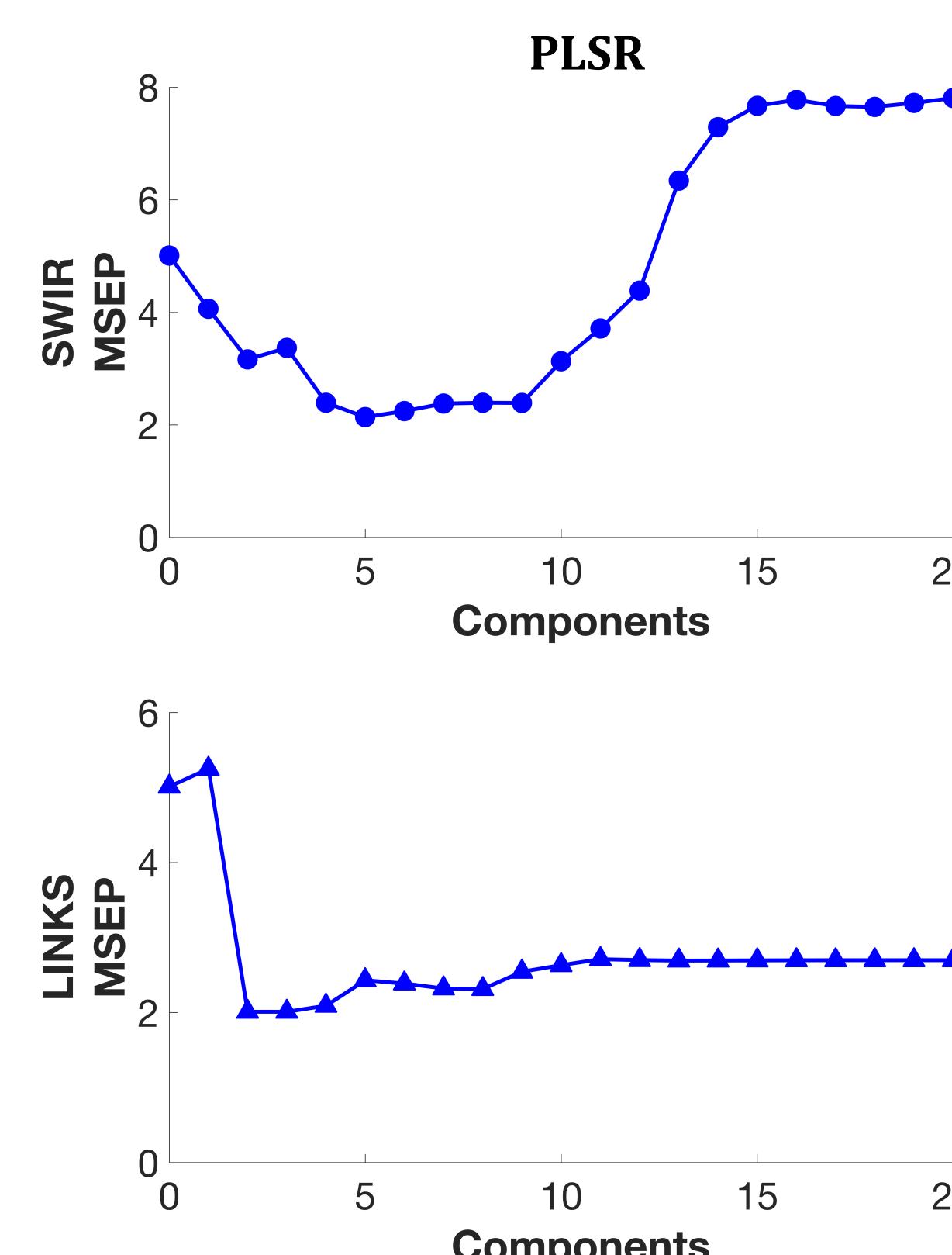
1. Collect NIR data from spectrometers
2. Removed background and noise from data
3. Determined mean spectra for each sample
4. Divide data into a training set and a test set
5. Using cross validation select
 - 5.1. training set to construct PCR and PLSR models
 - 5.2. Observed how well model performs at predicting test set

Results

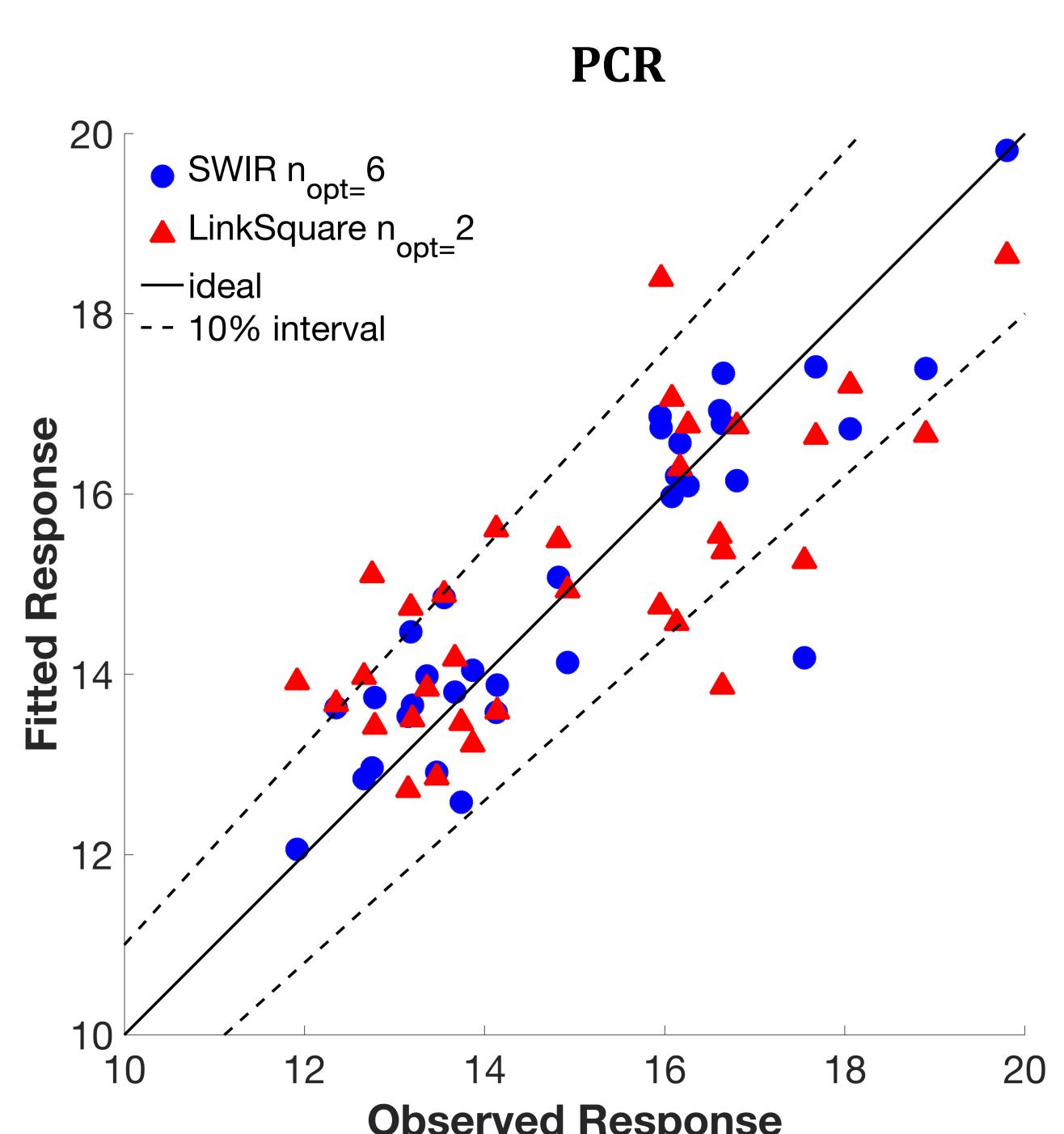
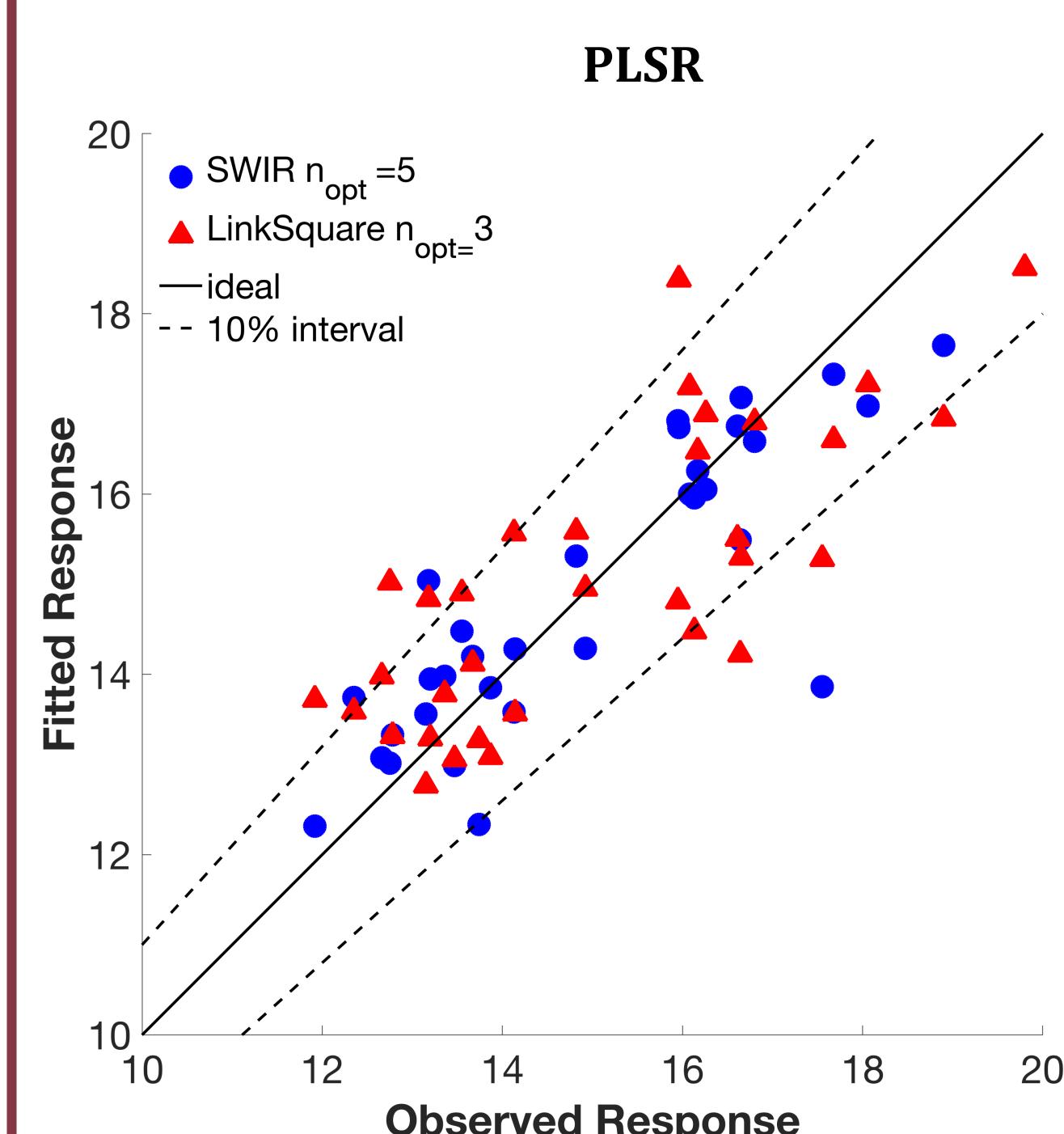
Mean Spectra from NIR analysis



Optimum number of components determined to construct regression model using cross validation.



Regression model performance



Comparison between the SWIR-384 and LinkSquare

Specifications	SWIR-384	LinkSquare
Price	R150 000	R8000
Spectral range	950-2500 μ m	400-1000 μ m
Weight	5.7 kg	0.0057 kg
Power consumption	30 W	>6 W
Scan	Image	One pixel(point)

Major findings

- A correlation between the Hypo number and NIR spectrum exists
- Acceptable performance for PLSR and PCR
- LinkSquare shows potential application in PPI