Automated Fish Classification Using Unprocessed Fatty Acid Chromatographic Data: A Machine Learning Approach

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INTRO

- **Gas Chromatography** is an analytical chemistry method that produces high-dimensional low-sample data.
- **This study** compares classification and feature selection when applied to gas chromatography data from fish oil.
- **Classification** to predict Fish Species and Body Parts, two datasets that share the same features.
- **Feature selection** to reduce the dimensionality, improve computation efficiency, and (even) improve classification performance.

METHODS

- **Evaluation:** average balanced classification accuracy over 10-fold cross-validation.
- 30 independent runs for each **classification** method.
- Each **feature selection** method for number of features in { 50, 100, ..., 4800 }. PSO was evaluated on 30 independent runs.

RESULTS

- Classification: **Linear SVM** performed best, with **near-perfect** accuracy for fish species, and best accuracy for body parts.
- Feature Selection: PSO has **improves** accuracy for fish species, using 25% of the features making it **4 times faster**.

DISCUSSION

- **Linear SVM** provides an **interpretable** and **accurate** model.
- **PSO/mRMR** feature selection **improve accuracy** and **efficiency**.
- Body Parts is harder to classify than Fish Species

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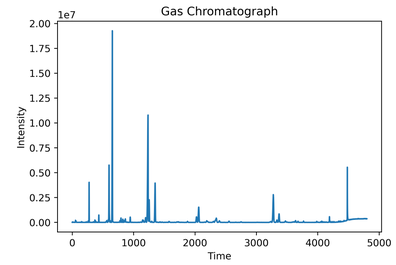
Linear SVM can accurately predict fish species, **PSO** makes that process 4 times faster, producing an **accurate**, **interpretable** and **efficient** model for **Gas Chromatography**.

Take a picture to download the full paper

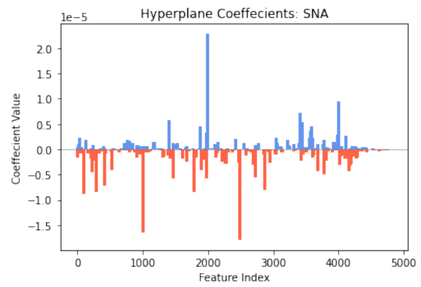
Gas Chromatogram - where x-axis is time, y-axis is intensity - for the Snapper **Fish Species**:



A table with **classification** results:

Dataset	Method	Train	Test
Species	KNN	83.57	74.88
	RF	100.0	85.65
	DT	100.0	76.98
	NB	79.54	75.27
	SVM	**100.0**	**98.33**
Parts	KNN	68.95	43.61
	RF	100.00	72.60
	DT	100.00	60.14
	NB	65.54	48.61
	SVM	**100.00**	**79.86**

Linear SVM hyperplane coefficients for the Snapper **Fish Species**:



A table best accuracy for **feature selection** methods:

Dataset	Method	# Features	Train	Test
Species	ReliefF	359	100.0	98.33
	mRMR	**1500**	**100.0**	**99.17**
	χ^2	3250	100.0	98.33
	PSO	**1192**	**100.0**	**99.17**
	Full	4800	100.0	98.33
Parts	ReliefF	1650	100.0	84.44
	mRMR	**1500**	**100.0**	**86.94**
	χ^2	1550	100.0	82.50
	PSO	1223	100.0	84.31
	Full	4800	100.0	79.86