Supplementary Material

# Supplementary Figures and Tables

## Supplementary Figures

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| leaf disease |

**Supplementary Figure 1.** **(A)** CK of Zhefujing83; **(B)** CK of AD516; **(C)** BYK of Zhefujing83; **(D)** BYK of AD516; **(E)** DWB of Zhefujing83; **(F)** DWB of AD516; (G) WKB of Zhefujing83; **(H)** WKB of AD516.

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| **Supplementary Figure 2** |

**Supplementary Figure 2.** The architecture of autoencoder. For HSI, the data dimensionalities from beginning to the end could be simply recorded as 390-64-32-64-390. For MIR, the change of dimensionalities could be simply recorded as 7468-64-16-64-7468. For LIBS, the change of dimensionalities could be simply recorded as 22036-256-64-256-22036.

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| epoch_acc |

**Supplementary Figure 3.** The relationship between epoch and training performances.

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| Full HSI83 and 516 |

**Supplementary Figure 4.** The CNN architecture of Full-HSI of Zhefujing83 and AD516.

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| Full-MIR 83 and 516 |

**Supplementary Figure 5.** The CNN architecture of Full-MIR of Zhefujing83 and AD516.

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| Full LIBS 83 and Full LIBS 516 |

**Supplementary Figure 6.** The CNN architecture of Full-LIBS of Zhefujing83 and AD516.

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| --- | --- |
| PCA HSI 83**(A)** | PCA HSI 516**(B)** |

**Supplementary Figure 7.** **(A)** The CNN architecture of PCA-HSI of Zhefujing83; **(B)** The CNN architecture of PCA-HSI of AD516.

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| --- | --- |
| PCA-MIR 83(A) | PCA-MIR 516**(B)** |

**Supplementary Figure 8.** **(A)** The CNN architecture of PCA-MIR of Zhefujing83; (**B)** The CNN architecture of PCA-MIR of AD516.

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| --- | --- |
| PCA-LIBS 83**(A)** | PCA-LIBS 516  **(B)** |

**Supplementary Figure 9.** **(A)** The CNN architecture of PCA-LIBS of Zhefujing83; **(B)** the CNN architecture of PCA-LIBS of AD516.

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| AE-HSI 83 and 516 |

**Supplementary Figure 10.** The CNN architecture of AE-HSI of Zhefujing83 and AD516.

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| AE-MIR 83 and 516 |

**Supplementary Figure 11.** The CNN architecture of AE-MIR of Zhefujing83 and AD516.

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| AE-LIBS 83  **(A)** | AE-LIBS 516  **(B)** |

**Supplementary Figure 12.** **(A)** The CNN architecture of AE-LIBS of Zhefujing83; **(B)** The CNN architecture of AE-LIBS of AD516.

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| Full HSI-MIR 83 and 516 |

**Supplementary Figure 13.** The CNN architecture of Full-HSI-MIR of Zhefujing83 and AD516.

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| Full HSI-LIBS 83 and 516 Full MIR-LIBS 83 and 516 Full HSI-MIR-LIBS 83 and 516 |

**Supplementary Figure 14.** The CNN architecture of Full-HSI-LIBS (Batch size=20), Full-MIR-LIBS (Batch size=20) and Full-HSI-MIR-LIBS (Batch size=10) of Zhefujing83 and AD516.

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| AE-PCA |

**Supplementary Figure 15.** The CNN architecture of AE-PCA-HSI-MIR, AE-PCA-HSI-LIBS, AE-PCA-MIR-LIBS and AE-PCA-HSI-MIR-LIBS of Zhefujing83 and AD516.

|  |  |
| --- | --- |
| PCA-HSI-MIR 83  **(A)** | PCA-HSI-MIR 516  **(B)** |

**Supplementary Figure 16.** **(A)** The CNN architecture of PCA-HSI-MIR of Zhefujing83; **(B)** The CNN architecture of PCA-HSI-MIR of AD516.

|  |  |
| --- | --- |
| PCA-HSI-LIBS 83  **(A)** | PCA-HSI-LIBS 516  **(B)** |

**Supplementary Figure 17. (A)** The CNN architecture of PCA-HSI-LIBS of Zhefujing83; **(B)** The CNN architecture of PCA-HSI-LIBS of AD516.

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| --- | --- |
| PCA-MIR-LIBS 83  (A) | PCA-MIR-LIBS 516  (B) |

**Supplementary Figure 18.** **(A)** The CNN architecture of PCA-MIR-LIBS of Zhefujing83; **(B)** The CNN architecture of PCA-MIR-LIBS of AD516.

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| PCA-HSI-MIR-LIBS 83 and 516 |

**Supplementary Figure 19.** The CNN architecture of PCA-HSI-MIR-LIBS of Zhefujing83 and AD516.

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| --- | --- |
| cal  (A) | val  **(B)** |
| pre  **(C)** | |

**Supplementary Figure 20.** The confusion matrix of the training set **(A)**, the validation set **(B)** and the test set **(C)** of Full-HSI of Zhefujing83.

**Supplementary Table 1.** ANOVA analysis of results of the training set of CNN for Full spectra, PCA features and AE features.

|  |  |  |  |
| --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c |
| 0 | - | 0.648 | 0.294 |
| 1 | 0.648 | - | 0.544 |
| 2 | 0.294 | 0.544 | - |

a accuracy of training set of Full spectra; b accuracy of training set of PCA features; c accuracy of training set of AE features; Sig. means significance.

**Supplementary Table 2.** ANOVA analysis of results of the validation set of CNN Full spectra, PCA features and AE features.

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| --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c |
| 0 | - | 0.801 | 0.093 |
| 1 | 0.801 | - | 0.145 |
| 2 | 0.093 | 0.145 | - |

a accuracy of validation set of Full spectra; b accuracy of validation set of PCA features; c accuracy of validation set of AE features; Sig. means significance.

**Supplementary Table 3.** ANOVA analysis of results of the test set of CNN for Full spectra, PCA features and AE features.

|  |  |  |  |
| --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c |
| 0 | - | 0.709 | 0.008 |
| 1 | 0.709 | - | 0.017 |
| 2 | 0.008 | 0.017 | - |

a accuracy of test set of Full spectra; b accuracy of test set of PCA features; c accuracy of test set of AE features; Sig. means significance.

**Supplementary Table 4.** ANOVA analysis of results of the training set of CNN for Full individual spectra, low-level fusion, mid-level fusion and high-level fusion.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c | 3d |
| 0 | - | 0.163 | 0.232 | 0.191 |
| 1 | 0.163 | - | 0.615 | 1.0 |
| 2 | 0.232 | 0.615 | - | 0.652 |
| 3 | 0.191 | 1.0 | 0.652 | - |

a accuracy of training set of Full individual spectra; b accuracy of training set of low-level fusion; c accuracy of training set of mid-level fusion; d accuracy of training set of high-level fusion; Sig. means significance.

**Supplementary Table 5.** ANOVA analysis of results of the validation set of CNN for Full individual spectra, low-level fusion, mid-level fusion and high-level fusion.

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| --- | --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c | 3d |
| 0 | - | 0.338 | 0.512 | 0.472 |
| 1 | 0.338 | - | 0.052 | 0.847 |
| 2 | 0.512 | 0.052 | - | 0.124 |
| 3 | 0.472 | 0.847 | 0.124 | - |

a accuracy of validation set of Full individual spectra; b accuracy of validation set of low-level fusion; c accuracy of validation set of mid-level fusion; d accuracy of validation set of high-level fusion; Sig. means significance.

**Supplementary Table 6.** ANOVA analysis of results of the test set of CNN for Full individual spectra, low-level fusion, mid-level fusion and high-level fusion.

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| --- | --- | --- | --- | --- |
| Sig. | 0a | 1b | 2c | 3d |
| 0 | - | 0.628 | 0.063 | 0.960 |
| 1 | 0.628 | - | 0.141 | 0.591 |
| 2 | 0.063 | 0.141 | - | 0.055 |
| 3 | 0.960 | 0.591 | 0.055 | - |

a accuracy of test set of Full individual spectra; b accuracy of test set of low-level fusion; c accuracy of test set of mid-level fusion; d accuracy of test set of high-level fusion; Sig. means significance.