Supervised Spectral Parameter Learning over Jezero Crater with the ESA ExoMars TGO CaSSIS Multiband Imager

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Visible-to-near-infrared imaging is an efficient way to explore a planet, but the material diversity of a scene is not always expressed in the standard browse products of a multiband imager. We present progress in the development of a new method, *Supervised Spectral Parameter Learning* (SSPL), that seeks optimal ways of stretching and combining multispectral bands to enhance contrast between pre-selected material groups [1, 2]. We report on empirical developments of the method through application to the Jezero Crater region, the landing sight of the Mars 2020 *Perseverance* rover, as explored pre-landing [e.g. 3]. We use the publicly available end-member profiles of the composition identified by [3] to investigate how the associated spectral diversity is sampled by the 4 spectral channels of the ESA Trace Gas Orbiter CaSSIS imager [4]. We compute all ratio, slope, band-depth and shoulder-height spectral parameters afforded by the 4 CaSSIS channels and fit a Linear Discriminant to each paired combination of these spectral parameters. The Linear Discriminant finds the line that maximises the separation, quantified by the Fisher Ratio, between the defined target class, in this study carbonates, against the background phyllosilicates and mafic silicates hypothesized by [3]. We use the Fisher Ratio score and linear discriminant classification accuracy (over 500 repeat trials with 80/20 train/test splitting) to rank the success of the spectral parameter paired combinations (SPCs). We apply the top ranking SPCs to the I/F calibrated MY37 027246 019 CaSSIS observation of Jezero Crater, and report on the success and limitations in sorting carbonates from phyllosilicates and basalts, in comparison to overlapping CRISM hyperspectral orbital data.

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[3] Horgan et al, 2020, Icarus, doi:10.1016/j.icarus.2019.113526.
[4] Thomas et al, 2017, Space Sci. Rev., doi:10.1007/s11214-017-0421-1