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5: * Written by Jelle Spijker <spijker.jelle@gmail.com>, 2015
6: */
7:
8: #pragma once
9:
10: #include "Particle.h"
11: #include "Sample.h"
12: #include "AnalysisResults.h"
13: #include "AnalyseType.h"
14: #include "soilsettings.h"
```

```
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6:  */
7:
8: #include "SampleAnalysisResult.h"
9:
10: namespace SoilAnalyzer {
11:     SampleAnalysisResult::SampleAnalysisResult() {}
12:
13:     SampleAnalysisResult::~SampleAnalysisResult() {}
14: }
```

```

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6:  */
7:
8:  // Source:
9:  // http://stackoverflow.com/questions/16125574/how-to-serialize-opencv-mat-with-boost-xml-archive
10: #pragma once
11:
12: #include <boost/archive/binary_iarchive.hpp>
13: #include <boost/archive/binary_oarchive.hpp>
14: #include <boost/serialization/access.hpp>
15: #include <opencv/cv.h>
16: #include <opencv2/core.hpp>
17:
18: namespace boost {
19: namespace serialization {
20: /*!
21: * \brief serialize Serialize the openCV mat to disk
22: */
23: template <class Archive>
24: inline void serialize(Archive &ar, cv::Mat &m, const unsigned int version __attribute__((unused))) {
25:     int cols = m.cols;
26:     int rows = m.rows;
27:     int elemSize = m.elemSize();
28:     int elemType = m.type();
29:
30:     ar &cols;
31:     ar &rows;
32:     ar &elemSize;
33:     ar &elemType; // element type.
34:
35:     if (m.type() != elemType || m.rows != rows || m.cols != cols) {
36:         m = cv::Mat(rows, cols, elemType, cv::Scalar(0));
37:     }
38:
39:     size_t dataSize = cols * rows * elemSize;
40:
41:     for (size_t dc = 0; dc < dataSize; dc++) {
42:         ar &m.data[dc];
43:     }
44: }
45: }
46: }

```

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6:  */
7:
8:  #pragma once
9:  #include <stdint.h>
10: #include <utility>
11: #include <vector>
12:
13: #include <boost/serialization/base_object.hpp>
14: #include <boost/serialization/utility.hpp>
15: #include <boost/serialization/vector.hpp>
16:
17: #include "AnalyseType.h"
18: #include "../SoilMath/SoilMath.h"
19:
20: namespace SoilAnalyzer {
21:  /*!
22:  * \brief The AnalysisResults class
23:  * \details the analysis results this is the base class for particle and soil
24:  * analysis results
25:  */
26:  class AnalysisResults {
27:  public:
28:    /*!
29:    * \brief AnalysisResults Constructor
30:    */
31:    AnalysisResults();
32:
33:    /*!
34:    * \brief AnalysisResult de-constructor
35:    */
36:    ~AnalysisResults();
37:
38:    std::vector<
39:        ucharStat_t> RGB_Stat; /**< A Vector with the Stats class for each color
40:                                channel in the RGB*/
41:    std::vector<floatStat_t> LAB_Stat;
42:    floatStat_t RI_Stat;
43:
44:  private:
45:    friend class boost::serialization::access;
46:    template <class Archive>
47:    void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
48:        ar &RGB_Stat;
49:        ar &LAB_Stat;
50:        ar &RI_Stat;
51:    }
52: };
53: }
```

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6:  */
7:
8:  #pragma once
9:  #define MIN_EDGE_PIXELS
10:  128 /**< the minimum amount of pixels needed as an edge before it can be
11:  analysed*/
12:  #define FFT_DESCRIPTOR 12 /**< the minimum amount of FFT descriptors*/
13:
14:  #include "AnalysisResults.h"
15:  #include "ShapeClassification.h"
16:  #include "../SoilVision/Vision.h"
17:
18:  #include <boost/serialization/base_object.hpp>
19:
20:  namespace SoilAnalyzer {
21:  /*!
22:  * \brief The ParticleAnalysisResults class
23:  * \details The Analysis results of an individual particle, it inherents form
24:  * the class AnalysisResults
25:  */
26:  class ParticleAnalysisResults : public AnalysisResults {
27:  public:
28:    bool Analyzed = false; /**< Indicates whether the results are analyzed*/
29:    bool SmallParticle = false; /**< Indicates if the particle is considered to
30:    small to analyze the voor shape*/
31:    uint32_t Area; /**< The total area of the particle as a pixel*/
32:    ShapeClassification Shape; /**< The Shape indicator*/
33:
34:    /*!
35:    * \brief ParticleAnalysisResults The constructor
36:    */
37:    ParticleAnalysisResults();
38:
39:    /*!
40:    * \brief Deconstructor
41:    */
42:    ~ParticleAnalysisResults();
43:
44:  private:
45:    friend class boost::serialization::access;
46:    template <class Archive>
47:    void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
48:      ar &Analyzed;
49:      ar &SmallParticle;
50:      ar &Area;
51:      ar &Shape;
52:      ar &BOOST_SERIALIZATION_BASE_OBJECT_NVP(AnalysisResults);
53:    }
54:  };
55: }

```

```
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6:  6:  */
7:
8:  #pragma once
9:  #include <boost/serialization/base_object.hpp>
10: #include <boost/serialization/utility.hpp>
11: #include <boost/serialization/complex.hpp>
12: #include <boost/serialization/vector.hpp>
13:
14: #include "../SoilMath/SoilMath.h"
15:
16: /*!
17: 17:  * \brief The ShapeClassification class the class which describes the shape as
18: 18:  * category and with FFT descriptor
19: 19:  */
20: class ShapeClassification {
21: public:
22:     unsigned char Category;          /**< The category class*/
23:     ComplexVect_t FFT_descriptors; /**< The Fast Fourier Descriptors*/
24:
25:     /*!
26:     26:  * \brief ShapeClassification the constructor
27:     27:  */
28:     ShapeClassification();
29:
30:     /*!
31:     31:  * \brief ShapeClassification the constructor
32:     32:  * \param fft_descriptors teh fast fourier descriptors
33:     33:  */
34:     ShapeClassification(ComplexVect_t fft_descriptors)
35:         : FFT_descriptors(fft_descriptors) {}
36:
37:     /*!
38:     38:  * \brief The descontructor
39:     39:  */
40:     ~ShapeClassification();
41:
42: private:
43:     friend class boost::serialization::access;
44:     template <class Archive>
45:     void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
46:         ar &Category;
47:         ar &FFT_descriptors;
48:     }
49: };
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```
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6:  */
7:
8: #pragma once
9:
10: #include <string>
11: #include <fstream>
12: #include <boost/archive/xml_iarchive.hpp>
13: #include <boost/archive/xml_oarchive.hpp>
14: #include "../SoilVision/Vision.h"
15:
16: namespace SoilAnalyzer {
17:  /*!
18:  * \brief The SoilSettings class
19:  * \details A class with which the used settings can easily transfered to setup
20:  * the Sample class in one go. This class is also used in the GUI. and has a
21:  * possibility to saved to disk as a serialized object
22:  */
23:  class SoilSettings {
24:  public:
25:    SoilSettings();
26:
27:    /*!
28:    * \brief SaveSettings a function to save the settings to disk
29:    * \param filename a string with the filename
30:    */
31:    void SaveSettings(std::string filename);
32:
33:    /*!
34:    * \brief LoadSettings a function to load the settings from disk
35:    * \param filename a string with the filename
36:    */
37:    void LoadSettings(std::string filename);
38:
39:    bool useAdaptiveContrast =
40:        true; /**< Should adaptive contrast stretch be used default is true*/
41:    uint32_t adaptContrastKernelSize =
42:        9; /**< The size of the adaptive contrast kernelsize*/
43:    float adaptContrastKernelFactor = 1.; /**< the factor with which to multiply
44:        the effect of the adaptive contrast
45:        stretch*/
46:
47:    bool useBlur = true; /**< Should the mediaan blur be used during analysys*/
48:    uint32_t blurKernelSize = 5; /**< the median blurkernel*/
49:
50:    Vision::Segment::TypeOfObjects typeOfObjectsSegmented =
51:        Vision::Segment::Dark; /**< Which type of object should be segmented*/
52:    bool ignorePartialBorderParticles =
53:        true; /**< Indication of partial border particles should be used*/
54:    bool fillHoles = true; /**< should the holes be filled*/
55:    float
56:        sigmaFactor = 2; /**< The sigma factor or the bandwidth indicating which
57:        pixel intensity values count belong to an object*/
58:    int thresholdOffsetValue = 0; /**< an tweaking offset value*/
59:
60:    Vision::MorphologicalFilter::FilterType morphFilterType =
61:        Vision::MorphologicalFilter::OPEN; /**< Indicating which type of
62:        morphpological filter should be
63:        used*/
64:    uint32_t filterMaskSize = 5; /**< the filter mask*/
65:
66:    uint32_t HDRframes =
67:        5; /**< The number of frames which should be used for the HDR image*/
68:    float lightLevel = 0.5; /**< The light level of the environmental case*/
69:    bool encInv = false; /**< invert the values gained form the encoder*/
70:    bool enableRainbow =
71:        true; /**< run a rainbow loop on the RGB encoder during analysis*/
72:
73:  private:
74:    friend class boost::serialization::access;
75:    template <class Archive>
76:    void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
77:        ar &BOOST_SERIALIZATION_NVP(useAdaptiveContrast);
78:        ar &BOOST_SERIALIZATION_NVP(adaptContrastKernelFactor);
79:        ar &BOOST_SERIALIZATION_NVP(adaptContrastKernelSize);
80:        ar &BOOST_SERIALIZATION_NVP(useBlur);
81:        ar &BOOST_SERIALIZATION_NVP(blurKernelSize);
82:        ar &BOOST_SERIALIZATION_NVP(typeOfObjectsSegmented);
83:        ar &BOOST_SERIALIZATION_NVP(ignorePartialBorderParticles);
```

```
84:     ar &BOOST_SERIALIZATION_NVP(fillHoles);
85:     ar &BOOST_SERIALIZATION_NVP(sigmaFactor);
86:     ar &BOOST_SERIALIZATION_NVP(morphFilterType);
87:     ar &BOOST_SERIALIZATION_NVP(filterMaskSize);
88:     ar &BOOST_SERIALIZATION_NVP(thresholdOffsetValue);
89:     ar &BOOST_SERIALIZATION_NVP(HDRframes);
90:     ar &BOOST_SERIALIZATION_NVP(lightLevel);
91:     ar &BOOST_SERIALIZATION_NVP(encInv);
92:     ar &BOOST_SERIALIZATION_NVP(enableRainbow);
93: }
94: };
95: }
```



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6:  */
7:
8:  #include "ShapeClassification.h"
9:
10: ShapeClassification::ShapeClassification() {}
11:
12: ShapeClassification::~ShapeClassification() {}
```

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6:  6:  */
7:
8:  #pragma once
9:
10: #include <boost/serialization/base_object.hpp>
11:
12: #include "Soil.h"
13: #include "../SoilMath/SoilMath.h"
14: #include "ParticleAnalysisResults.h"
15:
16: namespace SoilAnalyzer {
17:  17:  /*!
18:  18:  * \brief The Particle class
19:  19:  * \details Representing an individual particle
20:  20:  */
21:  class Particle : public Soil {
22:  public:
23:    23:    /*!
24:    24:    * \brief Particle the constructor
25:    25:    */
26:    Particle();
27:
28:    28:    /*!
29:    29:    * \brief the destructor
30:    30:    */
31:    ~Particle();
32:
33:    33:    /*!
34:    34:    * \brief Save the particle to disk
35:    35:    * \param filename string indicating the filename
36:    36:    */
37:    void Save(std::string &filename);
38:
39:    39:    /*!
40:    40:    * \brief Load load the particle from disk
41:    41:    * \param filename string indicating the filename
42:    42:    */
43:    void Load(std::string &filename);
44:
45:    ParticleAnalysisResults Analysis; /**< The Analysis results*/
46:
47:    47:    /*!
48:    48:    * \brief Analyze the function which analyses the particle
49:    49:    * \param nn the neural network to be used pased as a reference
50:    50:    * \return thes analysis results
51:    51:    */
52:    SoilAnalyzer::AnalysisResults Analyze(SoilMath::NN &nn);
53:
54:  private:
55:    friend class boost::serialization::access;
56:    template <class Archive>
57:    void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
58:      ar &BOOST_SERIALIZATION_BASE_OBJECT_NVP(Soil);
59:      ar &Analysis;
60:    }
61:  };
62: }
```

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6:  */
7:
8: #include "ParticleAnalysisResults.h"
9:
10: namespace SoilAnalyzer {
11: ParticleAnalysisResults::ParticleAnalysisResults() {}
12:
13: ParticleAnalysisResults::~ParticleAnalysisResults() {}
14: }
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6:  */
7:
8: #include "Soil.h"
9:
10: namespace SoilAnalyzer {
11:     Soil::Soil() {}
12:
13:     Soil::~~Soil() {}
14: }
```

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6:  */
7:
8:  #pragma once
9:  #include "AnalysisResults.h"
10: #include "ParticleAnalysisResults.h"
11: #include <boost/serialization/base_object.hpp>
12: #include <boost/serialization/vector.hpp>
13:
14: namespace SoilAnalyzer {
15:  /*!
16:  * \brief The SampleAnalysisResult class
17:  * \details The class where the results are stored
18:  */
19:  class SampleAnalysisResult : public AnalysisResults {
20:  public:
21:
22:      /*!
23:      * \brief SampleAnalysisResult the constructor
24:      */
25:      SampleAnalysisResult();
26:
27:      /*!
28:      * \brief The destructor
29:      */
30:      ~SampleAnalysisResult();
31:
32:  private:
33:      friend class boost::serialization::access;
34:      template <class Archive>
35:      void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
36:          ar &BOOST_SERIALIZATION_BASE_OBJECT_NVP(AnalysisResults);
37:      }
38:  };
39: }
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6:  */
7:
8: #pragma once
9:
10: #include <fstream>
11: #include <boost/archive/binary_iarchive.hpp>
12: #include <boost/archive/binary_oarchive.hpp>
13: #include <boost/serialization/string.hpp>
14: #include "Mat_archive.h"
15: #include <opencv2/core/core.hpp>
16: #include <stdint.h>
17: #include <string>
18: #include "../SoilVision/VisionDebug.h"
19:
20: namespace SoilAnalyzer {
21:  /*!
22:  * \brief The Soil class
23:  * \details The parent object of the Soil related objects
24:  */
25:  class Soil {
26:  private:
27:    friend class boost::serialization::access;
28:    template <class Archive>
29:    void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
30:      ar &ID;
31:      ar &Location;
32:      ar &TimeTaken;
33:      ar &TimeAnalyzed;
34:      ar &BW;
35:      ar &Intensity;
36:      ar &LAB;
37:      ar &RI;
38:      ar &RGB;
39:      ar &OptimizedInt;
40:    }
41:
42:  protected:
43:    cv::Mat OptimizedInt; /**< The enhanced int image*/
44:
45:  public:
46:    /*!
47:    * \brief Soil the constructor
48:    */
49:    Soil();
50:
51:    /*!
52:    * \brief Soil deconstructor
53:    */
54:    ~Soil();
55:    cv::Mat BW; /**< The black and white image consisting of values of 0 and 1
56:                  where 0 is the background*/
57:    cv::Mat
58:      Intensity; /**< The intensity image after it is converted from the RGB
59:                  color model*/
60:    cv::Mat LAB; /**< The CIE Lab color image*/
61:    cv::Mat RGB; /**< The RGB color image*/
62:    cv::Mat RI; /**< The individual RI image*/
63:    cv::Mat Edge; /**< The black and white image consisting of values of 0 and 1
64:                   where 0 is background and 1 is the edge of the blob*/
65:    uint8_t version; /**< the version of the object*/
66:    std::string
67:      TimeTaken; /**< a string indicating which time the sample was taken*/
68:    std::string
69:      TimeAnalyzed; /**< a string indicating which time it was analyzed*/
70:    std::string Location; /**< a string with the location of the soilsample*/
71:    uint32_t ID; /**< the sample ID*/
72:  };
73: }
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6:  */
7:
8:  #pragma once
9:  #include <exception>
10: #include <string>
11: #include <stdint.h>
12:
13: using namespace std;
14:
15: namespace SoilAnalyzer {
16: namespace Exception {
17: class AnalysisException : public std::exception {
18: public:
19:     AnalysisException(string m = "Analysis Failed!") : msg(m){}
20:     AnalysisException(string m = "Analysis Failed!", uint8_t id = 0) : msg(m) {
21:         exid = id;
22:     }
23:     ~AnalysisException() _GLIBCXX_USE_NOEXCEPT{}
24:     const char *what() const _GLIBCXX_USE_NOEXCEPT { return msg.c_str(); }
25:     const uint8_t ID() const _GLIBCXX_USE_NOEXCEPT { return exid; }
26:
27: private:
28:     string msg;
29:     uint8_t exid;
30: };
31: }
32: }
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6:  */
7:
8:  #include "Particle.h"
9:
10: namespace SoilAnalyzer {
11: Particle::Particle() {}
12:
13: Particle::~Particle() {}
14:
15: void Particle::Save(std::string &filename) {
16:     std::ofstream ofs(filename.c_str());
17:     boost::archive::binary_oarchive oa(ofs);
18:     oa << BOOST_SERIALIZATION_NVP(*this);
19: }
20:
21: void Particle::Load(std::string &filename) {
22:     std::ifstream ifs(filename.c_str());
23:     boost::archive::binary_iarchive ia(ifs);
24:     ia >> BOOST_SERIALIZATION_NVP(*this);
25: }
26:
27: SoilAnalyzer::AnalysisResults Particle::Analyze(SoilMath::NN &nn) {
28:     if (Analysis.Analyzed) {
29:         return Analysis;
30:     }
31:
32:     // Calc the LAB stats
33:     std::vector<cv::Mat> lab = Vision::ImageProcessing::extractChannel(LAB);
34:     for_each(lab.begin(), lab.end(), [&](cv::Mat &M) {
35:         Analysis.LAB_Stat.push_back(floatStat_t((float *)M.data, M.rows, M.cols));
36:     });
37:
38:     // Calc the RGB stats
39:     std::vector<cv::Mat> rgb = Vision::ImageProcessing::extractChannel(RGB);
40:     for_each(lab.begin(), lab.end(), [&](cv::Mat &M) {
41:         Analysis.RGB_Stat.push_back(ucharStat_t((uchar *)M.data, M.rows, M.cols));
42:     });
43:
44:     // Calc the Redness Index stats
45:     Analysis.RI_Stat = floatStat_t((float *)RI.data, RI.rows, RI.cols);
46:
47:     // Calc the area
48:     for_each(BW.data, BW.data + (BW.rows * BW.cols),
49:         [&](uchar P) { Analysis.Area += P; });
50:
51:     // Calc the edge area
52:     uint32_t edgeArea = 0;
53:     for_each(Edge.data, Edge.data + (Edge.rows * Edge.cols),
54:         [&](uchar P) { edgeArea += P; });
55:
56:     if (edgeArea >= MIN_EDGE_PIXELS) {
57:         Analysis.SmallParticle = false;
58:     } else {
59:         Analysis.SmallParticle = true;
60:     }
61:
62:     // Determine the shape Classification, but only for pixels that are big enough
63:     if (!Analysis.SmallParticle) {
64:         // Calculate the FFT Descriptors
65:         SoilMath::FFT fft;
66:         Analysis.Shape.FFT_descriptors = fft.GetDescriptors(Edge);
67:         if (Analysis.Shape.FFT_descriptors.size() >= FFT_DESCRIPTOR) {
68:             Analysis.Shape.FFT_descriptors.erase(
69:                 Analysis.Shape.FFT_descriptors.begin() + FFT_DESCRIPTOR,
70:                 Analysis.Shape.FFT_descriptors.end());
71:         } else {
72:             while (Analysis.Shape.FFT_descriptors.size() < FFT_DESCRIPTOR) {
73:                 Analysis.Shape.FFT_descriptors.push_back(Complex_t(0, 0));
74:             }
75:         }
76:
77:         Predict_t sp = nn.Predict(Analysis.Shape.FFT_descriptors);
78:         uchar i = 0;
79:         float maxValue = 0.0;
80:         for_each(sp.OutputNeurons.begin(), sp.OutputNeurons.end(), [&](float &n) {
81:             if (n > maxValue) {
82:                 Analysis.Shape.Category = i;
83:                 maxValue = n;

```



```
84:     }  
85:     i++;  
86: });  
87: }  
88: Analysis.Analyzed = true;  
89: return Analysis;  
90: }  
91: }
```

```
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5:  * Written by Jelle Spijker <spijker.jelle@gmail.com>, 2015
6:  */
7:
8: #include "AnalysisResults.h"
9:
10: namespace SoilAnalyzer {
11:     AnalysisResults::AnalysisResults() {}
12:
13:     AnalysisResults::~AnalysisResults() {}
14: }
```

```

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5:  5:  * Written by Jelle Spijker <spijker.jelle@gmail.com>, 2015
6:  6:  */
7:
8:  #pragma once
9:  9:  // #define DEBUG
10: #define PROG_INCR(status)
11:     currentProg += progstep;
12:     prog_sig(currentProg, status)
13: #include "Soil.h"
14: #include "Particle.h"
15: #include "AnalysisResults.h"
16: #include "AnalysisException.h"
17:
18: #include <boost/serialization/base_object.hpp>
19: #include <boost/serialization/vector.hpp>
20: #include "Mat_archive.h"
21:
22: #include <boost/signals2.hpp>
23: #include <boost/bind.hpp>
24:
25: #include <opencv2/core.hpp>
26: #include <opencv2/highgui.hpp>
27:
28: #include <vector>
29: #include <string>
30:
31: #include "../SoilVision/Vision.h"
32: #include "../SoilMath/SoilMath.h"
33: #include "soilsettings.h"
34:
35: using namespace std;
36: using namespace cv;
37:
38: namespace SoilAnalyzer {
39: 39:  /*!
40: 40:  * \brief The Sample class
41: 41:  * \details This class represent a single soilsample snapshot it inherents from
42: 42:  * the class Soil
43: 43:  */
44: class Sample : public Soil {
45: public:
46:     typedef boost::signals2::signal<void(
47:         float, std::string)> Progress_t; /**< A boost signal, used for progress
48:                                         update indicating the progres so far
49:                                         as a float between 0. and 1. and the
50:                                         current progress step as string*/
51:
52: 52:  /*!
53: 53:  * \brief connect_Progress used to connect the progress signal
54: 54:  * \param subscriber a reference to the subscriber
55: 55:  * \return returns the signal
56: 56:  */
57: boost::signals2::connection
58: connect_Progress(const Progress_t::slot_type &subscriber);
59:
60: 60:  /*!
61: 61:  * \brief Sample the constructor
62: 62:  * \param settings a pointer to the an object of the type SoilSettings used to
63: 63:  * initialize the analyzing settings
64: 64:  */
65: Sample(SoilSettings *settings = nullptr);
66:
67: 67:  /*!
68: 68:  * \brief Sample the constructor
69: 69:  * \param src the source rgb image
70: 70:  * \param settings a pointer to the an object of the type SoilSettings used to
71: 71:  * initialize the analyzing settings
72: 72:  */
73: Sample(const Mat &src, SoilSettings *settings = nullptr);
74:
75: 75:  /*!
76: 76:  * \brief The Deconstructor
77: 77:  */
78: ~Sample();
79:
80: cv::Mat OriginalImage; /**< The original image*/
81: vector<Particle> Population; /**< a Vector with original particles*/
82: AnalysisResults Results; /**< The analysis results*/
83:

```

```
84:   SoilSettings *Settings =
85:       nullptr; /**< The Settings used to initialize the analyzis*/
86:
87:   /*!
88:   * \brief PrepImg Prep te image for analysis
89:   * \param settings a pointer to the an object of the type SoilSettings used to
90:   * initialize the analyzing settings
91:   */
92:   void PrepImg(SoilSettings *settings = nullptr);
93:   bool imgPrepped = false; /**< */
94:
95:   /*!
96:   * \brief Analyse the RGB image
97:   * \param nn a reference to the neural network used during analyzing
98:   */
99:   void Analyse(SoilMath::NN &nn);
100:
101:   /*!
102:   * \brief Analyse the the RGB image
103:   * \param src the RGB image with needs to be analysed
104:   * \param nn a reference to the neural network used during analyzing
105:   */
106:   void Analyse(const Mat &src, SoilMath::NN &nn);
107:
108:   /*!
109:   * \brief Save the SoilSample to disk
110:   * \param filename the where to save
111:   */
112:   void Save(string &filename);
113:
114:   /*!
115:   * \brief Load the SoilSample from disk
116:   * \param filename where the saved Soilsample can be found
117:   */
118:   void Load(string &filename);
119:
120: private:
121:   Progress_t prog_sig; /**< The progress signal*/
122:
123:   friend class boost::serialization::access;
124:   template <class Archive>
125:   void serialize(Archive &ar, const unsigned int version __attribute__((unused))) {
126:       ar &BOOST_SERIALIZATION_BASE_OBJECT_NVP(Soil);
127:       ar &OriginalImage;
128:       ar &Population;
129:       ar &Results;
130:       ar &Settings;
131:       ar &imgPrepped;
132:   }
133:
134:   /*!
135:   * \brief AnalysePopVect analyse the particle population vector
136:   * \param population a reference to individual particles
137:   * \param results
138:   * \return
139:   */
140:   bool AnalysePopVect(const vector<Particle> &population,
141:                       AnalysisResults &results);
142:
143:   /*!
144:   * \brief SegmentParticles
145:   * \param segType
146:   */
147:   void SegmentParticles(
148:       Vision::Segment::SegmentationType segType = Vision::Segment::Normal);
149: };
150: }
```

```
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6:  */
7:
8:  #include "Sample.h"
9:
10: namespace SoilAnalyzer {
11:     Sample::Sample(SoilSettings *settings) { Settings = settings; }
12:
13:     Sample::Sample(const Mat &src, SoilSettings *settings) {
14:         Settings = settings;
15:         OriginalImage = src.clone();
16:     }
17:
18:     Sample::~Sample() {}
19:
20:     void Sample::Save(string &filename) {
21:         std::ofstream ofs(filename.c_str());
22:         boost::archive::binary_oarchive oa(ofs);
23:         oa << boost::serialization::make_nvp("SoilSample", *this);
24:     }
25:
26:     void Sample::Load(string &filename) {
27:         std::ifstream ifs(filename.c_str());
28:         boost::archive::binary_iarchive ia(ifs);
29:         ia >> boost::serialization::make_nvp("SoilSample", *this);
30:     }
31:
32:     void Sample::PrepImg(SoilSettings *settings) {
33:         // setup the settings
34:         if (settings == nullptr && Settings == nullptr) {
35:             Settings = new SoilSettings;
36:         } else if (Settings != nullptr) {
37:             Settings = settings;
38:         }
39:
40:         // Determine the biggest kernelsize. These border pixels are discarded with
41:         // the optimized int
42:         uint32_t kBOrder = ((Settings->adaptContrastKernelSize > Settings->blurKernelSize)
43:                             ? Settings->adaptContrastKernelSize : Settings->blurKernelSize);
44:         uint32_t khBorder = kBOrder / 2;
45:
46:         // set up the progress signal
47:         float currentProg = 0.;
48:         prog_sig(currentProg, "Starting segmentation");
49:
50:         uint32_t totalsteps = 5;
51:         if (Settings->useAdaptiveContrast) {
52:             totalsteps++;
53:         }
54:         if (Settings->useBlur) {
55:             totalsteps++;
56:         }
57:         if (Settings->fillHoles) {
58:             totalsteps++;
59:         }
60:         if (Settings->ignorePartialBorderParticles) {
61:             totalsteps++;
62:         }
63:         if (Settings->morphFilterType != Vision::MorphologicalFilter::NONE) {
64:             totalsteps++;
65:         }
66:         float progstep = 1. / static_cast<float>(totalsteps);
67:
68:         if (OriginalImage.empty()) {
69:             throw Exception::AnalysisException("No Image found to analyze!", 1);
70:         }
71:         SHOW_DEBUG_IMG(OriginalImage, uchar, 255, "RGB", false);
72:
73:         // Convert the image to an intensity image and an enhanced Intinsity for
74:         // better segmentation
75:         Vision::Conversion RGBConverter(OriginalImage);
76:         RGBConverter.Convert(Vision::Conversion::RGB, Vision::Conversion::Intensity);
77:         PROG_INCR("Converted to intensity");
78:         Intensity = RGBConverter.ProcessedImg.clone();
79:         SHOW_DEBUG_IMG(Intensity, uchar, 255, "Intensity", false);
80:
81:         // Enhance the image with an Adaptive contrast stretch and/or followed by a
82:         // blur
83:         Vision::Enhance IntEnhance(Intensity);
```

```
84:  if (Settings->useAdaptiveContrast) {
85:      IntEnhance.AdaptiveContrastStretch(Settings->adaptContrastKernelSize,
86:                                         Settings->adaptContrastKernelSize);
87:      PROG_INCR("Adaptive contrast stretch applied");
88:      if (Settings->useBlur) {
89:          IntEnhance.Blur(Settings->blurKernelSize, true);
90:          PROG_INCR("Blur applied");
91:      }
92:  } else if (Settings->useBlur) {
93:      IntEnhance.Blur(Settings->blurKernelSize, false);
94:      PROG_INCR("Blur applied");
95:  } else {
96:      IntEnhance.ProcessedImg = IntEnhance.OriginalImg;
97:  }
98:  OptimizedInt =
99:      IntEnhance.ProcessedImg(cv::Rect(khBorder, khBorder,
100:                                     OriginalImage.cols - kBorder,
101:                                     OriginalImage.rows - kBorder)).clone();
102:  SHOW_DEBUG_IMG(OptimizedInt, uchar, 255, "IntEnhance", false);
103:
104:  // Segment the Dark Objects en fill the holes
105:  Vision::Segment Segmenter(OptimizedInt);
106:  Segmenter.sigma = Settings->sigmaFactor;
107:  Segmenter.thresholdOffset = Settings->thresholdOffsetValue;
108:  Segmenter.ConvertToBW(Settings->typeOfObjectsSegmented);
109:  PROG_INCR("Threshold applied");
110:  if (Settings->fillHoles) {
111:      Segmenter.FillHoles(true);
112:      PROG_INCR("Holes filled");
113:  }
114:  if (Settings->ignorePartialBorderParticles) {
115:      Segmenter.RemoveBorderBlobs(1, true);
116:      PROG_INCR("Border Blobs removed");
117:  }
118:  SHOW_DEBUG_IMG(Segmenter.ProcessedImg, uchar, 255, "Segmenter", true);
119:
120:  // Erode the segmented image and sets the BW image use it to create the NO
121:  // background RGB
122:  Vision::MorphologicalFilter Filter(Segmenter.ProcessedImg);
123:  uint kSize = Settings->filterMaskSize;
124:  Mat mask = cv::Mat::zeros(kSize, kSize, CV_8UC1);
125:  circle(mask, Point(kSize / 2, kSize / 2), (kSize / 2) + 1, 1, -1);
126:  switch (Settings->morphFilterType) {
127:  case Vision::MorphologicalFilter::CLOSE:
128:      Filter.Close(mask);
129:      PROG_INCR("Morphological filer - close applied");
130:      break;
131:  case Vision::MorphologicalFilter::DILATE:
132:      Filter.Dilation(mask);
133:      PROG_INCR("Morphological filer - dilate applied");
134:      break;
135:  case Vision::MorphologicalFilter::ERODE:
136:      Filter.Erosion(mask);
137:      PROG_INCR("Morphological filer - erode applied");
138:      break;
139:  case Vision::MorphologicalFilter::OPEN:
140:      Filter.Open(mask);
141:      PROG_INCR("Morphological filer - open applied");
142:      break;
143:  case Vision::MorphologicalFilter::NONE:
144:      Filter.ProcessedImg = Filter.OriginalImg;
145:  }
146:  BW = Filter.ProcessedImg.clone();
147:  SHOW_DEBUG_IMG(BW, uchar, 255,
148:                 "BW after segmentation, fill holes and erosion", true);
149:  RGB = Vision::ImageProcessing::CopyMat<uchar>(
150:      OriginalImage(cv::Rect(khBorder, khBorder, OriginalImage.cols - kBorder,
151:                             OriginalImage.rows - kBorder)).clone(),
152:      BW, CV_8UC1);
153:  PROG_INCR("RGB masked image generated");
154:  SHOW_DEBUG_IMG(RGB, uchar, 255, "RGB no Background", false);
155:
156:  // Create the Edge image
157:  Vision::Segment Edger(BW);
158:  Edger.GetEdgesEroding();
159:  Edge = Edger.ProcessedImg;
160:  PROG_INCR("Edge filter applied");
161:  SHOW_DEBUG_IMG(Edge, uchar, 255, "Edge", true);
162:
163:  // Make the CIE La*b* conversion
164:  Vision::Conversion RGBnewConvertor(RGB);
165:  RGBnewConvertor.Convert(Vision::Conversion::RGB, Vision::Conversion::CIE_lab);
166:  LAB = RGBnewConvertor.CopyMat<float>(RGB, BW, CV_32F);
```

```

167:  PROG_INCR("CIE La*b* conversion calculated");
168:  SHOW_DEBUG_IMG(LAB, float, 1.0, "LAB", true);
169:
170:  // Create the Redness Index
171:  Vision::Conversion LABConverter(LAB);
172:  LABConverter.Convert(Vision::Conversion::CIE_lab, Vision::Conversion::RI);
173:  RI = LABConverter.ProcessedImg;
174:  PROG_INCR("Redness conversion calculated");
175:  SHOW_DEBUG_IMG(RI, float, 1.0, "RI", true);
176:
177:  imgPrepped = true;
178: }
179:
180: void Sample::Analyse(SoilMath::NN &nn) {
181:     if (!imgPrepped) {
182:         PrepImg();
183:     }
184:     // Calculate the statistics CIE La*b*
185:     // vector<Mat> LABextract = Vision::ImageProcessing::extractChannel(LAB);
186:     // for_each(LABextract.begin(), LABextract.end(), [&](Mat &lab) {
187:     // Results.LAB_Stat.push_back(floatStat_t((float *)lab.data, lab.rows,
188:     // lab.cols)); });
189:
190:     // Calculate the statistics RI
191:     // Results.RI_Stat = floatStat_t((float *)RI.data, RI.rows, RI.cols);
192:
193:     // Segment and analyze the particles
194:     SegmentParticles(Vision::Segment::SegmentationType::Normal);
195:     // for_each(Population.begin(), Population.end(), [&](Particle &P)
196:     //{
197:     //     P.Analyse(nn);
198:     //});
199:
200:     // Analyze the image
201: }
202:
203: void Sample::Analyse(const Mat &src, SoilMath::NN &nn) {
204:     OriginalImage = src;
205:     Analyse(nn);
206: }
207:
208: bool Sample::AnalysePopVect(const vector<Particle> &population,
209:                             AnalysisResults &results) {
210:     return true;
211: }
212:
213: void Sample::SegmentParticles(Vision::Segment::SegmentationType segType) {
214:     Vision::Segment Segmenter(BW);
215:
216:     // Get the Particlelist
217:     Segmenter.GetBlobList();
218:     Population.resize(Segmenter.BlobList.size());
219:     uint32_t i = 0;
220:     // Analyze each particle
221:     for_each(Population.begin(), Population.end(), [&](Particle &P) {
222:         P.ID = Segmenter.BlobList[i].Label;
223:         P.Analysis.Analyzed = false;
224:         P.BW = Segmenter.BlobList[i].Img.clone();
225:         cv::Rect ROI = Segmenter.BlobList[i].ROI;
226:         P.Intensity =
227:             Vision::Segment::CopyMat<uchar>(Intensity(ROI).clone(), P.BW, CV_8UC1);
228:         P.LAB = Vision::Segment::CopyMat<float>(LAB(ROI).clone(), P.BW, CV_32FC3);
229:         P.RGB = Vision::Segment::CopyMat<uchar>(LAB(ROI).clone(), P.BW, CV_8UC3);
230:         P.RI = Vision::Segment::CopyMat<float>(LAB(ROI).clone(), P.BW, CV_32FC1);
231:         P.Edge = Vision::Segment::CopyMat<uchar>(Edge(ROI).clone(), P.BW, CV_8UC1);
232:         i++;
233:     });
234: }
235:
236: boost::signals2::connection
237: Sample::connect_Progress(const Progress_t::slot_type &subscriber) {
238:     return prog_sig.connect(subscriber);
239: }
240: }

```

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6:  */
7:
8: #pragma once
9: namespace SoilAnalyzer {
10: /*!
11:  * \brief The AnalyseType enum
12:  */
13: enum AnalyseType { S_LAB, S_PSD, S_RI, S_ROUNDNESS };
14: }
```



```
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6:  */
7:
8:  #include "soilsettings.h"
9:
10: namespace SoilAnalyzer {
11:     SoilSettings::SoilSettings() {}
12:
13:     void SoilSettings::LoadSettings(string filename) {
14:         std::ifstream ifs(filename.c_str());
15:         boost::archive::xml_iarchive ia(ifs);
16:         ia >> boost::serialization::make_nvp("SoilSettings", *this);
17:     }
18:
19:     void SoilSettings::SaveSettings(string filename) {
20:         std::ofstream ofs(filename.c_str());
21:         boost::archive::xml_oarchive oa(ofs);
22:         oa << boost::serialization::make_nvp("SoilSettings", *this);
23:     }
24: }
```