Drape Image Processing

Progress report summary on shape features,
preliminary analysis and further stages

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Plan Overview and Current Progress:

- ✓ Image pre-processing: grayscale, resize
- ✓ Geometric correction: inverse barrel distortion model
- ✓ Segmentation: optimal thresholding, edge detection
- ✓ Boundary registration: cubic spline interpolation, resample
- ✓ Enhancements to the segmentation process
- ✓ Drape shape registration: shape descriptors (features)

- Drape shape analysis: classifiers/regressors
- System optimization and evaluation

Implemented shape descriptors:

- **8-value basic statistics (1st order) for each feature function:**
  - min, max, range, mean, stdev, skewness, kurtosis, entropy

- **Various shape-related feature functions implemented:**
  - XY-value, complex-value and radial/angular boundary data series
  - Fourier descriptors of boundary signal
  - Power spectrum + fractal exponent
  - Curvature, zero-crossings, derivatives, weighted zero-crossings
  - Signal peaks, drape folds, angular distribution of folds
  - inertia moments, max/min ratio of principal axes
  - total perimeter length, total area, circularity index
  - .....

Preliminary analysis:

- Single-feature analysis shows little to no explicit correlation to the physical parameters of cloth samples.
- Initial cloth grouping shows poor statistics and limited applicability as basis for supervised classification or clustering models.
- Adaptive regression models were used instead, to estimate the predictability of several physical parameters of the cloth samples.

Preliminary results:

- Regression models: CART (classification and regression trees), w/Knn (weighted K-nearest neighbor).
- First results are promising (Abs.Rel.Error <10%) but more experiments are required for predicting specific physical parameters of cloth samples.

Future Work (AUA):

Next major tasks:

1. Selection of a small set of important physical parameters of the cloth samples, employed as regression “targets” (prediction).
2. Feature set optimization for each “target” parameter.
3. Application of several adaptive regression models and conduct objective performance analysis (k-fold cross validation)
4. Decide on optimal classification and/or regression schemes.
5. Provide the final framework for a practical system.