Automated extraction of crater rims on 3D meshes with an artificial neural network

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Context/Motivation

Motivation:

- Crater density measures the *age of geological units*
- Crater morphology traces the *impacts history*

State-of-the art:

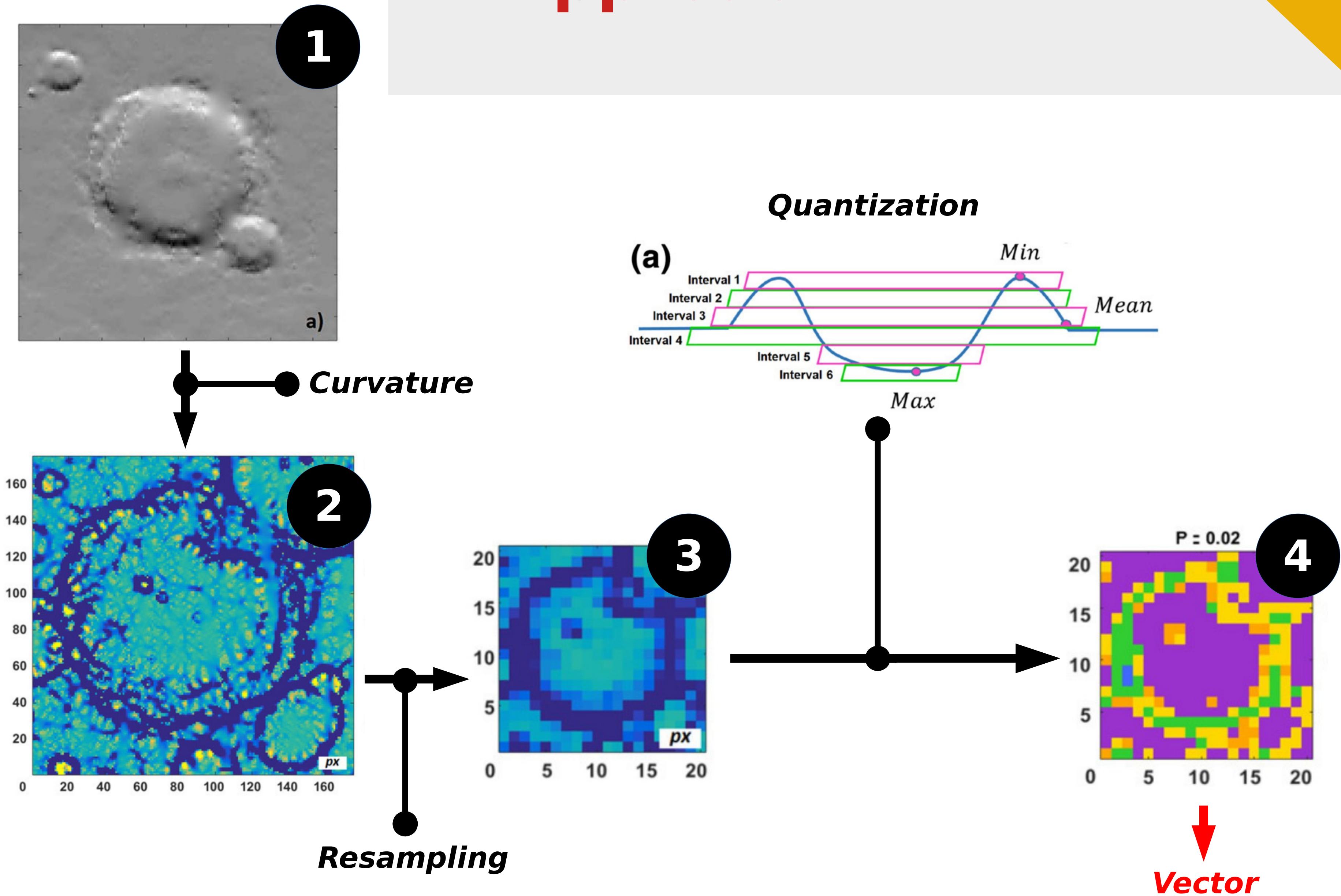
- Input data: images or digital terrain models (DTMs)
- Most crater identification made manually by geologists
- Some automatic methods proposed but none really adopted

Approach:

➡ *Machine learning to detect crater rims ?*

➡ *Mars DTMs (3D mesh) as input*

Approach


1
a)
Curvature
2
px
Resampling
3
px
Quantization
(a)
Interval 1
Interval 2
Interval 3
Interval 4
Interval 5
Interval 6
Min
Mean
Max
P = 0.02
4
Vector

Approach

NN Approach:

- “feedforward multilayer perceptron w/supervised learning” *[*]*

  - optimal with 50 neurons (found automatically during training)

  - three phases: training, validation, test

  - probability of a vector to belong to a class (crater VS non crater)

- in practice …

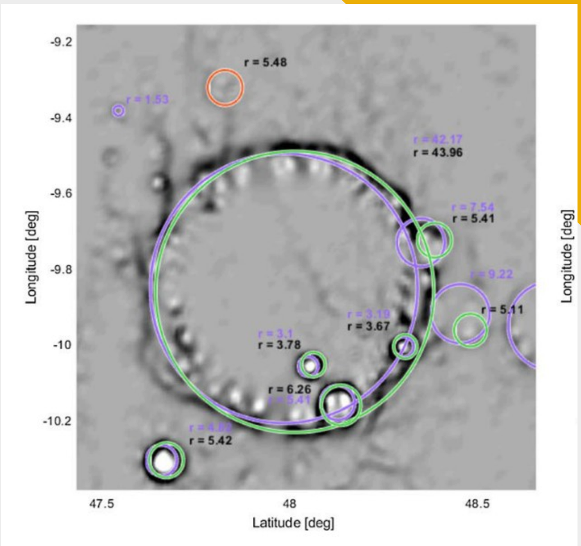
  - 3 areas (~3600 craters) used for training & validation

  - comparison with existing craters catalogs

  - implemented in the Matlab “ML toolbox”

[*]N. Kasabov, Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering (The MIT Press, Cambridge, 1996)

Results



<u>Main result:</u>

- improved crater detection
  - up to 96 % in some areas (!)
  - depends on crater density
  - further identification of crater rims (size & location)