A GPU Sonar simulator for automatic target recognition

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***Abstract:*** *Template matching is a common technique used when classifying objects in synthetic aperture sonar (SAS) images. The principle is to isolate an image segment containing an object of interest, correlate it with a set of template images, and assign it to the class of the template yielding the highest correlation coefficient. The challenge is to come up with a suitable set of template images considering that no seabed or object is truly alike.*

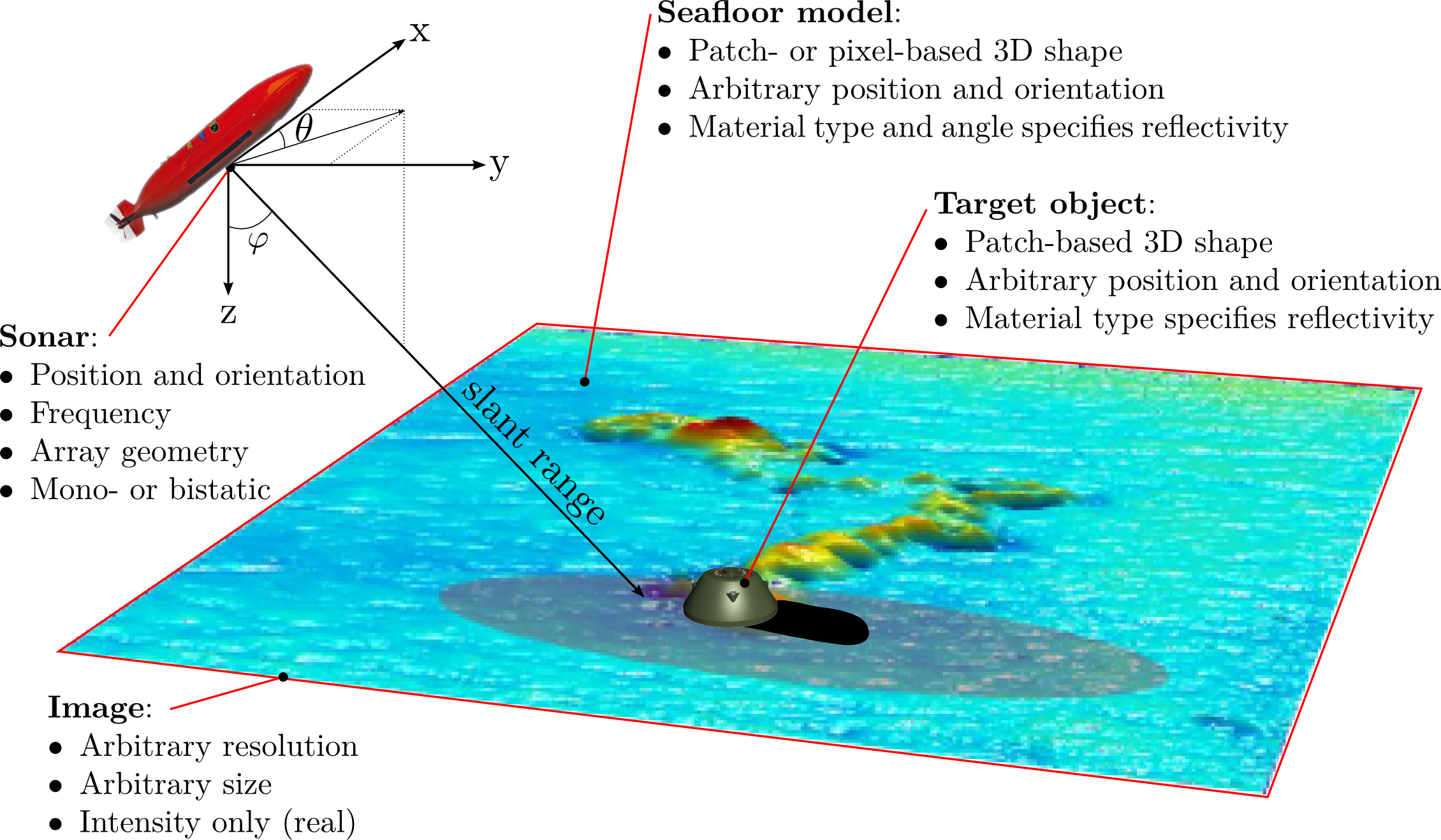
*We target this challenge with a sonar simulator that first take as input a seabed model derived from the real sonar image. Then it places an object model on the seabed, renders the scene, and adds the resulting image to the template set. For any object position, alignment, type and material, the procedure is repeated, and a correlation coefficient computed. The faster we are able to perform these simulations, the better we can expect the classification result to be. Therefore the simulator is written in OpenGL and OpenCL and run on graphics processing units (GPUs).*

*The result is a fast performing, mobile and portable on-the-fly template generator which can adapt its behavior to the nature of the current scene. We believe this can prove a powerful tool for mobile sonar imaging platforms such as autonomous underwater vehicles (AUVs).*

**Keywords:** sonar, simulator, ATR, automatic target recognition

1. INTRODUCTION
2. **METHODS**

The sonar svene



*Fig.1: Sonar simulator features.*

SAS – orthographic rendering

OpenGL scene rendering + depth

OpenCL sonar image construction

# GINTRODUCTION

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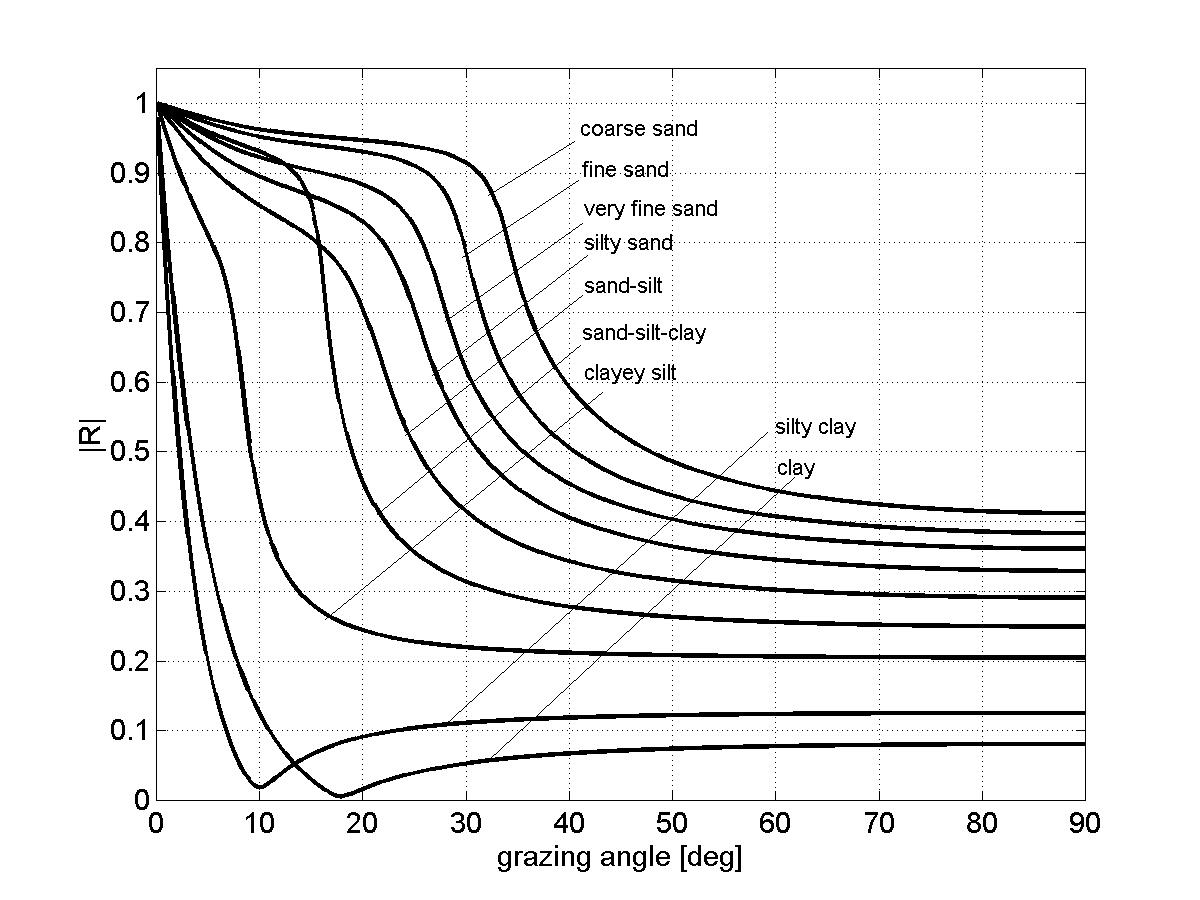
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*Fig.1: Reflection coefficient at the water-sediment interface for the sediment types listed in table 1.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sediment type | *M*z  (φ) | n | *ρ*2  g/cm3] | *c*2  [m/s] | *α*2 [dB/λ] | *c*s,2  [m/s] | *h*  [cm] |
| Clay | 9 | 0.80 | 1.2 | 1470 | 0.08 | - | 0.5 |
| Silty clay | 8 | 0.75 | 1.3 | 1485 | 0.10 | - | 0.5 |
| Clayey silt | 7 | 0.70 | 1.5 | 1515 | 0.15 | 125 | 0.6 |
| Sand-silt-clay | 6 | 0.65 | 1.6 | 1560 | 0.20 | 290 | 0.6 |
| Sand-silt | 5 | 0.60 | 1.7 | 1605 | 1.00 | 340 | 0.7 |
| Silty sand | 4 | 0.55 | 1.8 | 1650 | 1.10 | 390 | 0.7 |
| Very fine sand | 3 | 0.50 | 1.9 | 1680 | 1.00 | 410 | 1.0 |
| Fine sand | 2 | 0.45 | 1.95 | 1725 | 0.80 | 430 | 1.2 |
| Coarse sand | 1 | 0.40 | 2.0 | 1800 | 0.90 | 470 | 1.8 |

*Table 1: Geo-acoustic parameters of unconsolidated sediments.*

Acknowledgements

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