

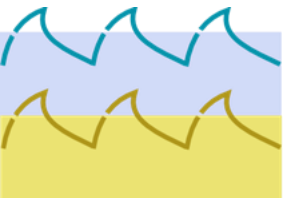
Optical channel– Quick how-to and exercises

Padova (Italy)

29th of January – 2rd of February 2024

Filippo Campagnaro

filippo.campagnaro@unipd.it



Optical– tcl examples

- Navigate in the desert with em example folder
 - `cd /DESERT_Framework/DESERT/samples/desert_samples/Channel/Optical`

Today we analyze two examples:

- **test_uwoptical_prop.tcl**
 - Model bases phy
- **test_uwopticalbeampattern.tcl**
 - LUT based phy

test_uwoptical_prop.tcl

```
#
# Stack of the nodes
# +-----+
# | 7. UW/CBR |
# +-----+
# | 6. UW/UDP |
# +-----+
# | 5. UW/STATICROUTING |
# +-----+
# | 4. UW/IP |
# +-----+
# | 3. UW/MLL |
# +-----+
# | 2. UW/CSMA_ALOHA |
# +-----+
# | 1. UW/OPTICAL/PHY |
# +-----+
# |           |           |
# +-----+
# | UW/Optical/Channel |
# +-----+
```



test_uwoptical_prop.tcl

```
#####
# Tcl variables #
#####
set opt(nn)                2.0 ;# Number of Nodes
set opt(pktsize)           125 ;# Pkt size in byte
set opt(starttime)        1
set opt(stoptime)          1000
set opt(txduration)        [expr $opt(stoptime) - $opt(starttime)] ;# Duration
set opt(ack_mode)          "setNoAckMode"
set opt(maxinterval_)      10.0

set opt(freq)              10000000
set opt(bw)                100000
set opt(bitrate)           1000000
set opt(txpower)           50
set opt(LUTpath)            "../dbs/optical_noise/LUT.txt";#"dbs/optical_noise/ALOMEX_optical_noise_
3_47_15__036d24.565m_001d40.534m_wl531.50_fileCTD001.txt";
set opt(atten_LUT)          "../dbs/optical_attenuation/lut_532nm/lut_532nm_CTD001.csv"
set opt(cbr_period)        0.1
set opt(pktsize)           125
set opt(rngstream)         1
```



test_uwoptical_prop.tcl

```
#Setup positions
$position($id) setX_ [expr $id*0]
$position($id) setY_ [expr $id*2]
$position($id) setZ_ [expr $id * 5 - 119];#-15.5
```

NOISE LUT

0.6
21
0 0
1 0.85285
2 0.48938
3 0.28058
4 0.16084
5 0.092201
6 0.052865
7 0.030318
8 0.017392
9 0.0099793
10 0.0057275
11 0.003288
12 0.001888
13 0.0010844
14 0.00062307
15 0.00035809
16 0.00020585
17 0.00011837
18 6.8079e-05
19 3.9167e-05
20 2.254e-05



test_uwoptical_prop.tcl - results

Simulation summary

number of nodes : 2.0
packet size : 125 byte
cbr period : 0.1 s
number of nodes : 2.0

Mean Throughput : 4938.1171919999997
Sent Packets : 19917.0
Received Packets : 19917.0

Ex 1: reproduce the results

Ex 2: change node position and check the results

- Keep the same depth and change distance between nodes (from 10 meters to 200 meters)
- Keep the same distance and change depth of the nodes (the shallowest node from -1 m to 20 m, the deepest 5 meter below)



test_uwoptical_prop.tcl

- Provide results of the exercises as plots of PDR vs range

test_uwopticalbeampattern.tcl

```
# Stack of the nodes
# +-----+
# | 7. UW/CBR |
# +-----+
# | 6. UW/UDP |
# +-----+
# | 5. UW/STATICROUTING |
# +-----+
# | 4. UW/IP |
# +-----+
# | 3. UW/MLL |
# +-----+
# | 2. UW/CSMA_ALOHA |
# +-----+
# | 1. UW/UWOPTICALBEAMPATTERN |
# +-----+
# |           |           |
# +-----+
# | UW/Optical/Channel |
# +-----+
```

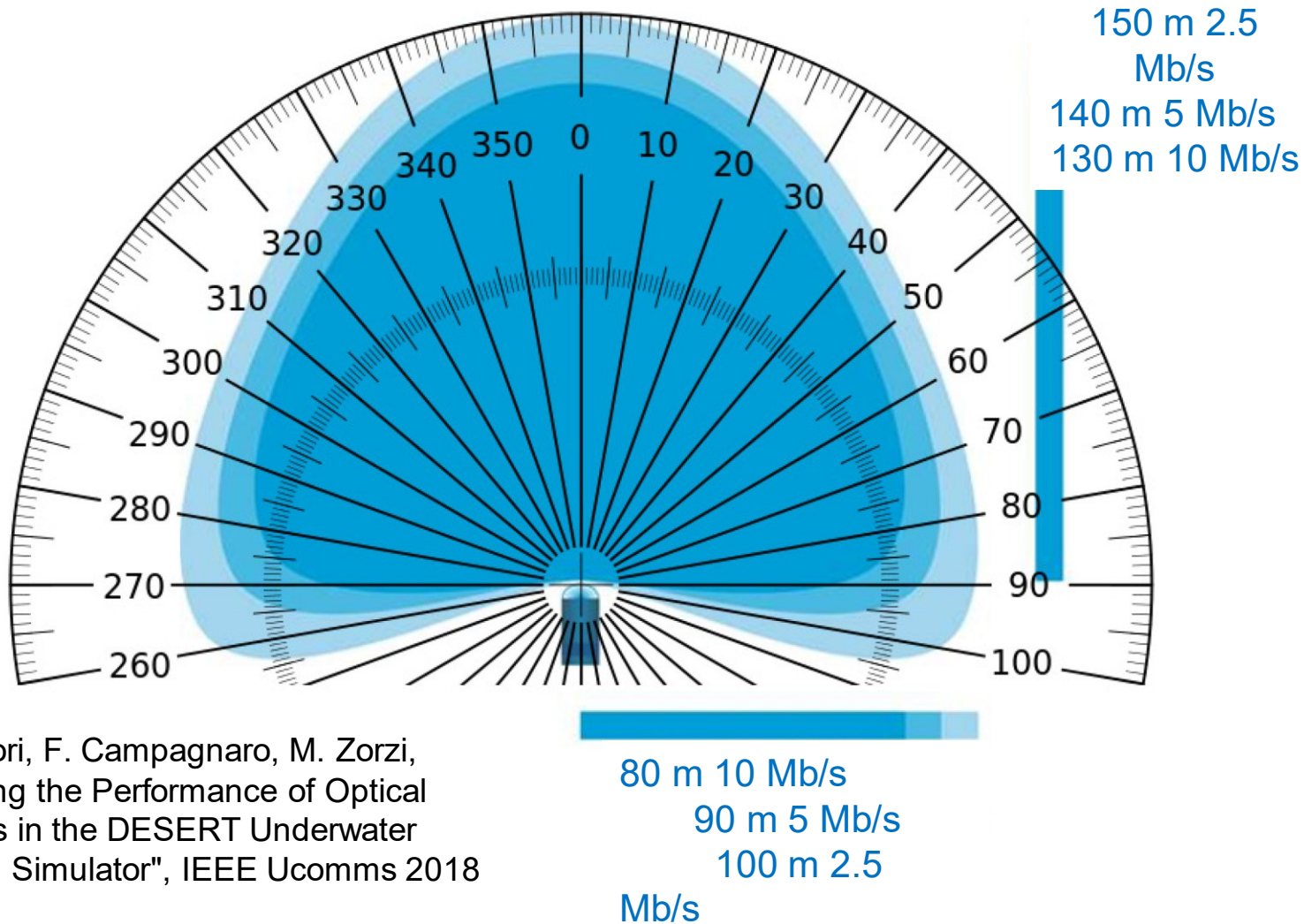


test_uwopticalbeampattern.tcl

- Same as before, just we consider the beam pattern of a real modem instead of omnidirectional beam patterns

```
set opt(beam_lut_path)      "../..//dbs/bluecomm/beam_pattern/beam5mbps.csv";#  
_2015_11_02__13_47_15__036d24.565m_001d40.534m_wl531.50_fileCTD001.txt";  
set opt(range_lut_path)     "../..//dbs/bluecomm/max_range/max_range5mbps.csv"
```

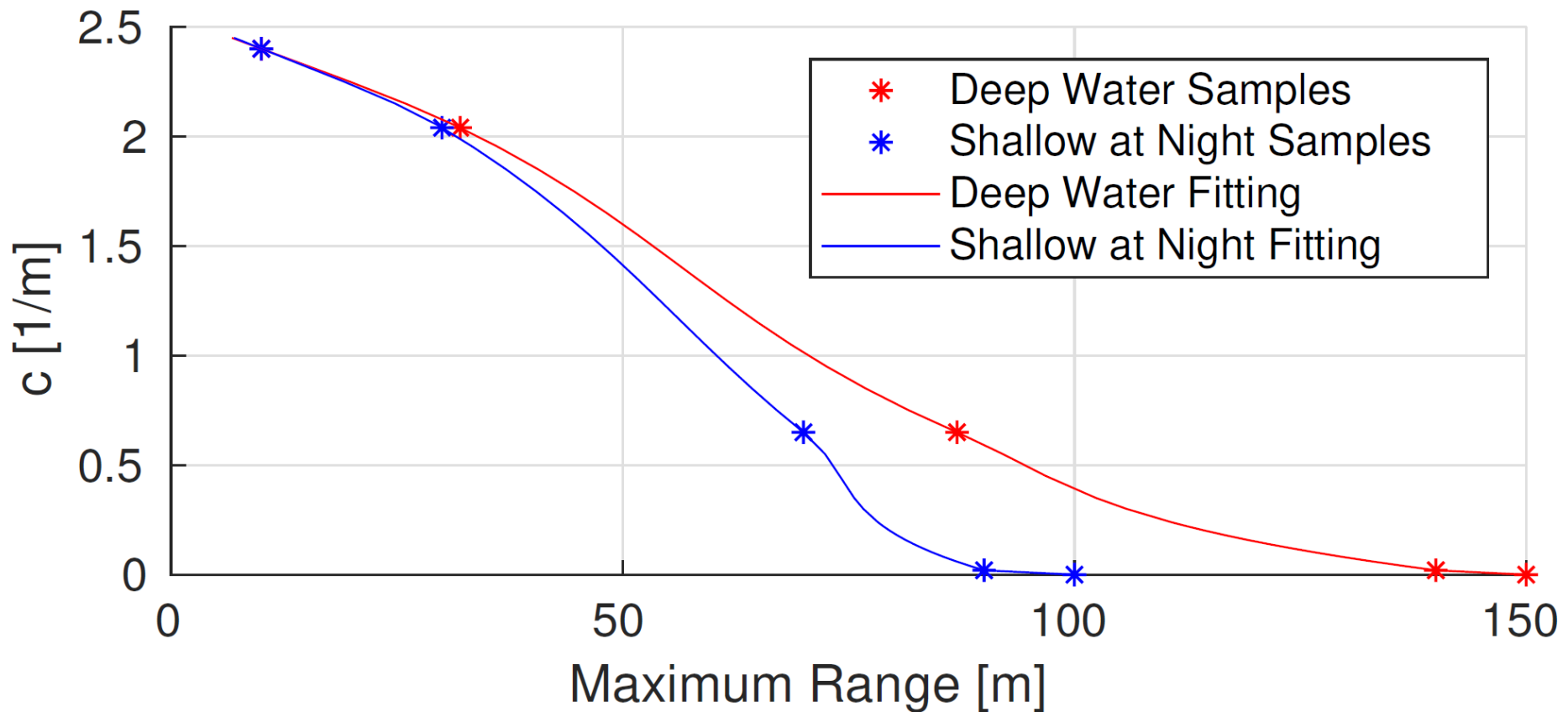
Real modem beam pattern



A. Signori, F. Campagnaro, M. Zorzi,
"Modeling the Performance of Optical
Modems in the DESERT Underwater
Network Simulator", IEEE Ucomms 2018

Real modem max range

- BlueComm 200 max range in different conditions



... beampattern.tcl - inclination and position

```
if {$id == 0} {  
    $phy($id) setInclinationAngle [expr - 3.14 / 2]  
} else {  
    $phy($id) setInclinationAngle [expr 3.14 / 2]  
}  
  
$ipif($id) addr [expr $id + 1]  
  
set position($id) [new "Position/BM"]  
$node($id) addPosition $position($id)  
  
#Setup positions  
$position($id) setX_ [expr $id*0]  
$position($id) setY_ [expr $id*0]  
$position($id) setZ_ [expr -5 - $id*100]
```



... beampattern.tcl - results

Simulation summary

number of nodes : 2.0
packet size : 125 byte
cbr period : 0.1 s
number of nodes : 2.0

Sent Packets : 9919
Received Packets : 0
Sent Packets : 9852
Received Packets : 9819
Mean Throughput : 0.0
Sent Packets : 19771.0
Received Packets : 9819.0



..._beampattern.tcl - Exercise 1

- PDR is not 100%: why?
- Objective: test different positions and inclination angle