Probabilistic Connectivity of Underwater Sensor Networks

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Overview

1. First Section
   - Subsection Example
2. Second Section

Why UWSNs?

UWSNs fuelled by many important underwater sensing applications and services such as

- **Scientific applications**: e.g., observing geological processes on the ocean floor, determining water characteristics, counting or imaging animal life
- **Industrial applications**: e.g., monitoring and control of commercial activities, determining routes for underwater cables, monitoring underwater equipment and pipelines for oil and mineral extraction, and monitoring commercial fisheries
- **Military and homeland security applications**: e.g., monitoring and securing port facilities
- **Humanitarian applications**: e.g., search and survey missions, disaster prevention tasks, identification of seabed hazards, locating dangerous rocks or shoals, and identifying possible mooring locations

Challenges of the underwater communication channel

Radio Communication

- suffer strong attenuation in salt water
- short distances (6-20 m) and low data rates (1 Kbps)
- require large antennas and high transmission power

Optical Communication

- strongly scattered and absorbed underwater
- limited to short distances (40 m)

Acoustic Communication

- suffers from attenuation, spreading, and noise
- very long delay because of low propagation speed.
- it is most practical method upto now

Challenges due to node mobility

Static Deployment

- nodes attached to underwater ground, anchored buoys, or docks
-

Semi-mobile Deployment

- nodes attached to a free floating buoy
- subject to small scale movement

Mobile Deployment

- composed of drifters with self/noself mobile capability
- are subject to large scale movement
- maintaining connectivity is important to perform localization, routing etc.

Kinematic Model

We note that this area is new to networking researchers where the obtained analytical results are rooted in the mathematically deep field of fluid dynamics.

- A particle pathline is a path followed by an individual particle in a flow
- A *stream* function denoted by ψ measures the volume flow rate per unit depth.
- Curves where ψ is constant are called *streamlines*

The stream function can be presented

$$\psi(x, y, t) = -\tanh\left[\frac{y - B(t)\sin(k(x - ct))}{\sqrt{1 + k^2 B^2(t)\cos^2(k(x - ct))}}\right] + cy \qquad (1)$$

where $B(t) = A + \epsilon\cos(\omega t)$ and the x and y velocities are given by

$$\dot{x} = -\frac{\partial\psi}{\partial y}; \dot{y} = \frac{\partial\psi}{\partial x} \qquad (2)$$

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Integer lectus nisl, ultricies in feugiat rutrum, porttitor sit amet augue. Aliquam ut tortor mauris. Sed volutpat ante purus, quis accumsan dolor.

Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table: Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)
Title of the publication
Journal Name 12(3), 45 – 678.

The End