

# **Contact-Free Neonatal Heart Rate and Respiratory Rate Monitor**

Duong N<sup>1</sup>, Houghtaling A<sup>1</sup>, Xia S<sup>1</sup>, Lenz B<sup>1</sup>, Singh H<sup>2</sup>, McAdams RM<sup>3</sup> <sup>1</sup>University of Wisconsin, Department of Biomedical Engineering, <sup>2</sup>Child Health Imprints, <sup>3</sup>University of Wisconsin School of Medicine and Public Health, Department of Pediatrics

#### BACKGROUND

Vital sign monitoring of neonates in the NICU currently requires the attachment of physical electrodes, which has drawbacks including wiring that hinders caretakers from assisting neonates, damage to fragile neonatal skin, and the cost disposable supplies. Ultra-Wideband Impulse Radio (IR-UWB) is a wireless way to monitor heart rate (HR) and respiratory rate (RR) without physical contact.

#### METHODS

- A Novelda X4M03 radar development kit was used detect HR and RR, powered and connected to PC by a microUSB cable.
- The sensor was fitted into the 3Dprinted sensor housing made out of PLA and connected to an articulating clamp.
- An algorithm was developed, which utilized Fast Fourier Transforms to isolate HR and RR. Python 3.6 was used to stream and analyze radar data.
- Static and movement testing was conducted on adult subjects using observer RR counting and pulse oximeter (HR) and using a SimNewB<sup>®</sup> newborn manikin (Laerdal, New York) Neonatal Simulator system with Compact Compressor unit.



#### RESULTS

In adult subjects (n=6), static comparison yielded a 1.75% error for HR and almost 0% error for RR; motion significantly disrupted HR and RR calculation (30% and 56% error, respectively). SimNewB<sup>®</sup> newborn manikin validation testing at 6 RRs (10, 20, 30, 40, 50, and 60 breaths per minute; measurements done in triplicate) showed a strong relationship (correlation coefficient: 0.99).

Bland-Altman analysis demonstrated low range of differences and within the limits of agreement, ± 5% tolerance.



We were able to create a contactless monitoring system utilizing IR-UWB by interfacing mechanical fixtures, electronic hardware, and data processing algorithms. Testing in adult human subjects and using a SimNewB<sup>®</sup> newborn manikin demonstrated accuracy with RR monitoring. Future work will focus on pilot testing in neonates in the NICU environment. The IR-UWB device holds vast potential for applications in the NICU and beyond, including home healthcare, airports, and public spaces.

### **ADDITIONAL KEY INFORMATION**

### **Author Contact Information:**

Neal Duong, nqduong@wisc.edu Angela Houghtaling, houghtaling@wisc.edu Bella Lenz, ilenz@wisc.edu Susan Xia, sxia29@wisc.edu

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## UwHealth

**American Family** Children's Hospital



**Department of Pediatrics** JNIVERSITY OF WISCONSIN SCHOOL OF MEDICINE AND PUBLIC HEALTH

#### CONCLUSIONS

Next step is testing in the NICU in India, gathering formalized human trials data Working toward developing a clinically impactful research paper

Dr. Amit Nimunkar, UW-Madison Dr. Sung Ho Cho, Hanyang University Mr. Won Hyuk, Hanyang University Dr. Tyler Caraza-Harter, UW-Madison Mr. Adam Tyler