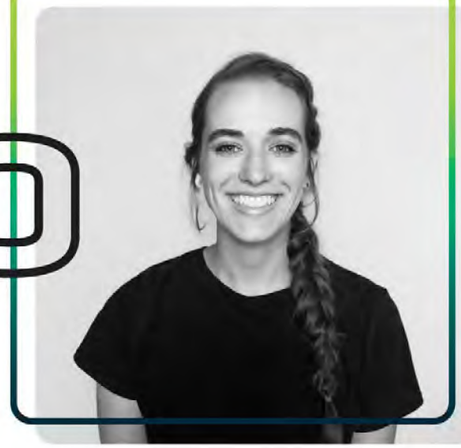
GABI LORENZO



MECHANICAL ENGINEER & SPORTS PRODUCT DESIGNER

I AM ENERGIZED BY SOLVING COMPLEX PROBLEMS.

I BELIEVE THAT GREAT DESIGN CAN ALWAYS BE IMPROVED.

TAU

HOW CAN WE HELP FEMALE DISTANCE RUNNERS REACH THEIR PEAK PERFORMANCE USING SENSOR-EQUIPPED FOOTWEAR?

REAL-TIME FEEDBACK OF SHEAR FORCES AT THE FOOT-SHOE INTERFACE CAN HELP THE ATHLETE CORRECT HER GAIT TO RUN FASTER & RUN LONGER

PROJECT IMPORTANCE

WHAT IS SHEAR?

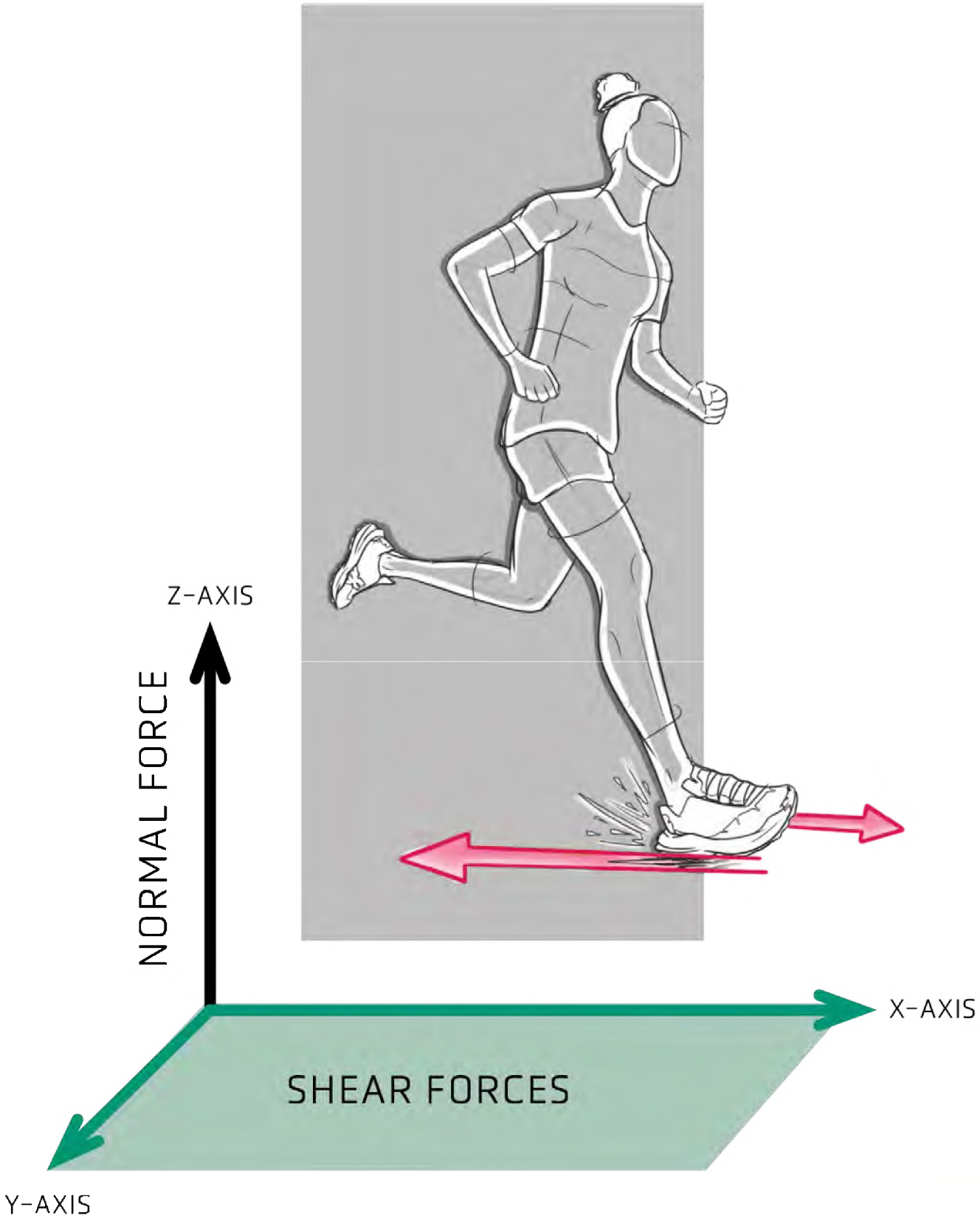
- Shear makes up 2/3 of the ground reaction forces that occur while running
- These forces allow an athlete to propel themselves forward, brake, or change direction; without shear, we could only jump upwards

IS SHEAR NEW?

- Measuring shear stress at the foot-shoe interface is extremely difficult & has not been done before
- Currently, only normal forces can be easily measured (1/3 of the forces that occur)

BENEFITS OF MEASURING SHEAR

- Understanding how shear changes throughout a run will provide opportunities to improve performance efficiencies & biomechanics


Z-AXIS
NORMAL FORCE
X-AXIS
SHEAR FORCES
Y-AXIS

ATHLETE & ENVIRONMENT

FEMALE DISTANCE RUNNERS

- 20 to 35 years old
- Specializing in 10k to marathon distances

ELITE ATHLETES

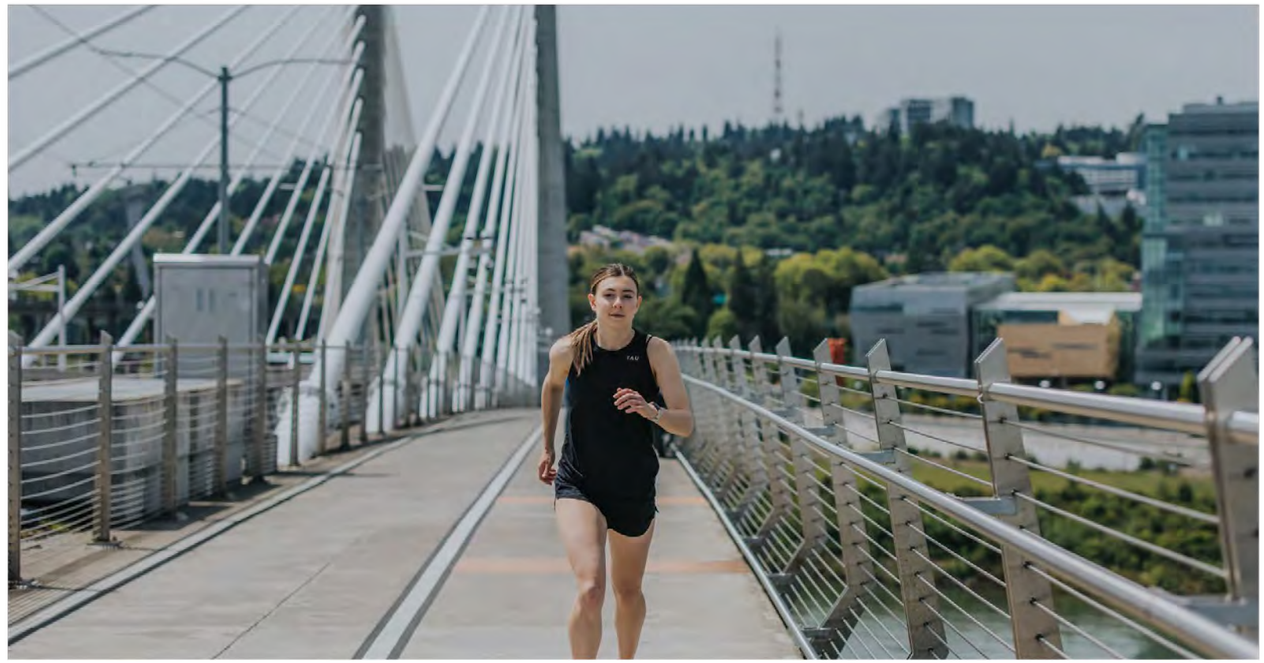
- Women who run at a high level & strive for constant improvement
- Athletes who trust technology to teach them efficiency

SPRING IN PORTLAND, OREGON

- Designed for unpredictable precipitation & slick surfaces

ROAD & TRAIL

- Two version for however she wants to train



AREAS OF INNOVATION

TAU-TECH

- Sensor that accurately measures multi-axial shear stress at the foot-shoe interface
- Records real-time feedback via Bluetooth to an app

IMPULSE INTEGRATION SYSTEM

- Sole unit construction that imperceptibly integrates the sensor with no plantar pressure hot spots
- Provides high-energy return with dialed-in flexibility & impact attenuation

ACTIVO-ARCH

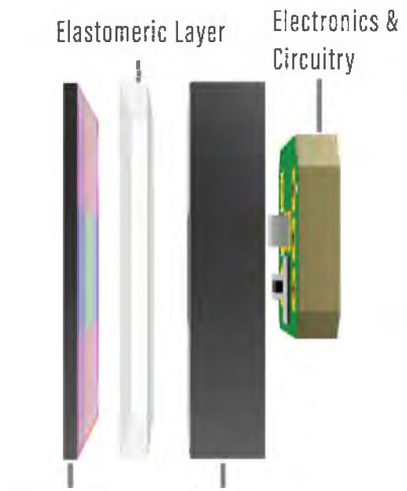
- Medial cage designed to provide the athlete with the perception of support & increase lockdown on declines
- Arch activiation & support is especially important for female athletes

TOTALIS TRACTION

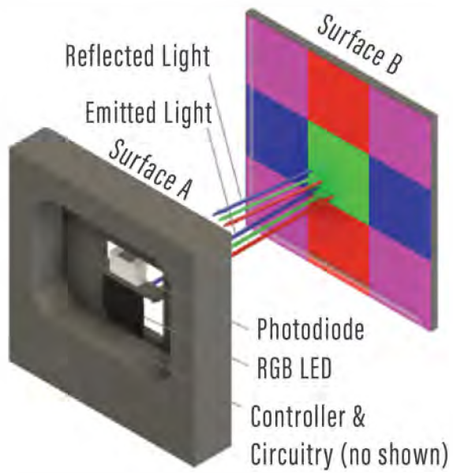
- Trail & road traction patterns that provide confident grip in wet conditions

THE SENSOR

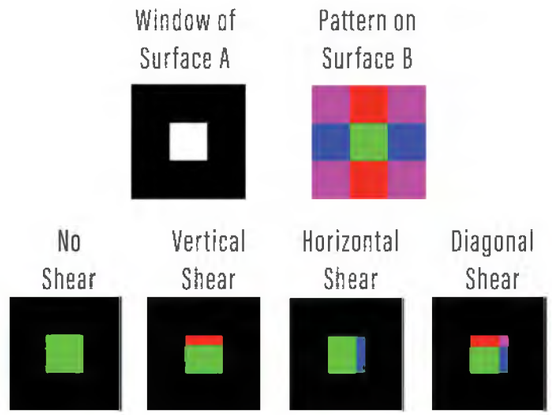
SENSOR ARCHITECTURE



SENSOR FUNCTION



VISUALIZATION OF SHEARING



SENSOR CONSTRAINTS

- PLANE OF ZERO DISPLACEMENT TO MEASURE DISPLACEMENT FROM
- SENSOR IS RIGID BUT NEEDS TO BE IMPERCEPTIBLY INTEGRATED INTO A DEFORMABLE BODY
- DEFORMABLE BODY NEEDS TO SHIFT ACROSS THE COLOR PATTERN

DEVELOPMENT TEAM

BIOMECHANICS
BOWERMAN SPORTS SCIENCE CENTER

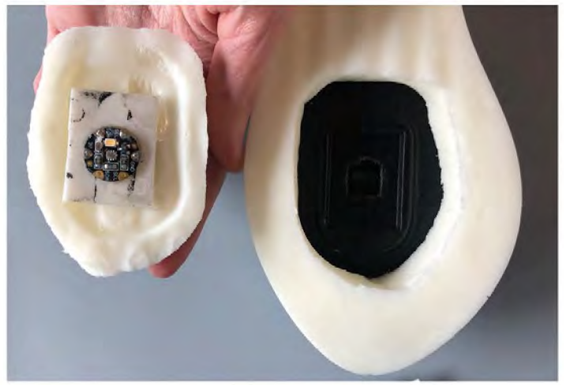
MIKE HAHN

BIOMECH. & ENGR.
BSSC & KNIGHT CAMPUS

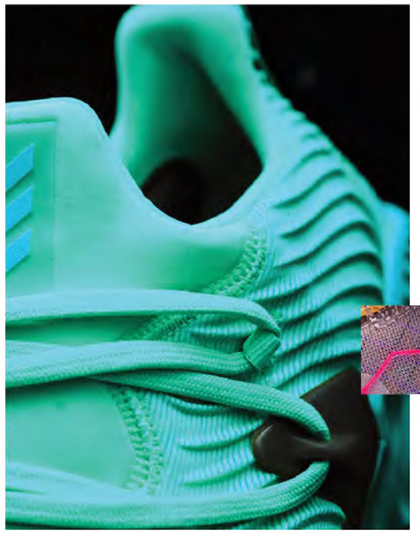
MICHAEL MCGEEHAN

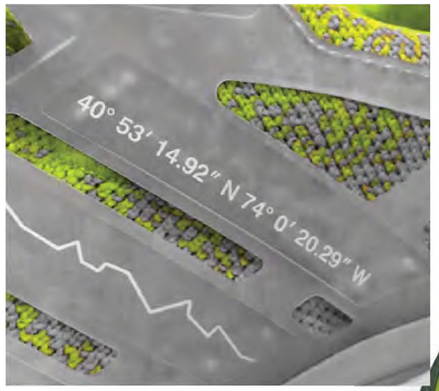
ELECTRICAL ENGINEERING
KNIGHT CAMPUS

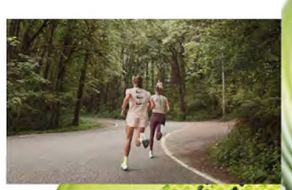
GHEE KEAT ONG

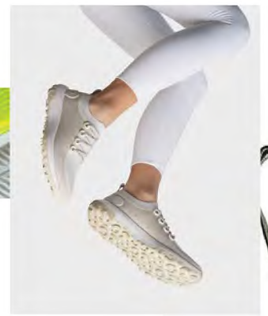


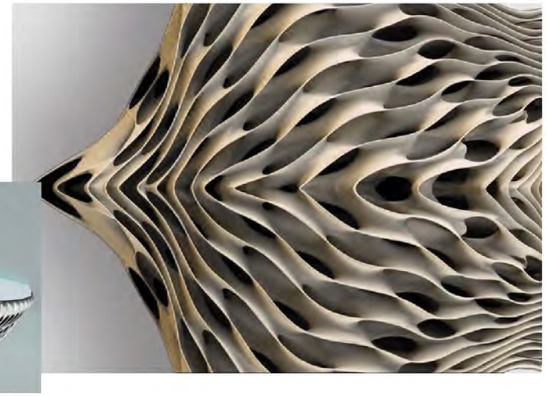
INSPIRATION & COLOR









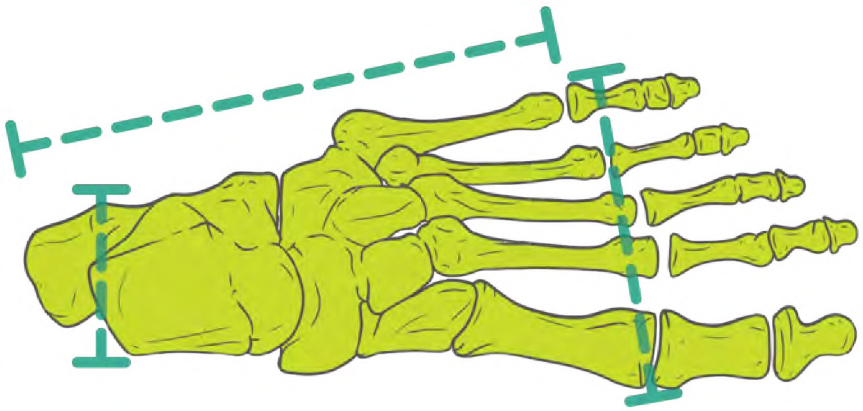


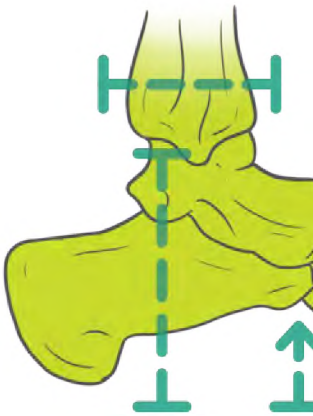
ROAD COLORWAY		
	15-4305 TCX	QUARRY
	12-0703 TCX	SEEDPEARL
	14-0340 TCX	ACID LIME
	12-0741 TCX	SUNNY LIME
	18-1856 TCX	VIRTUAL PINK

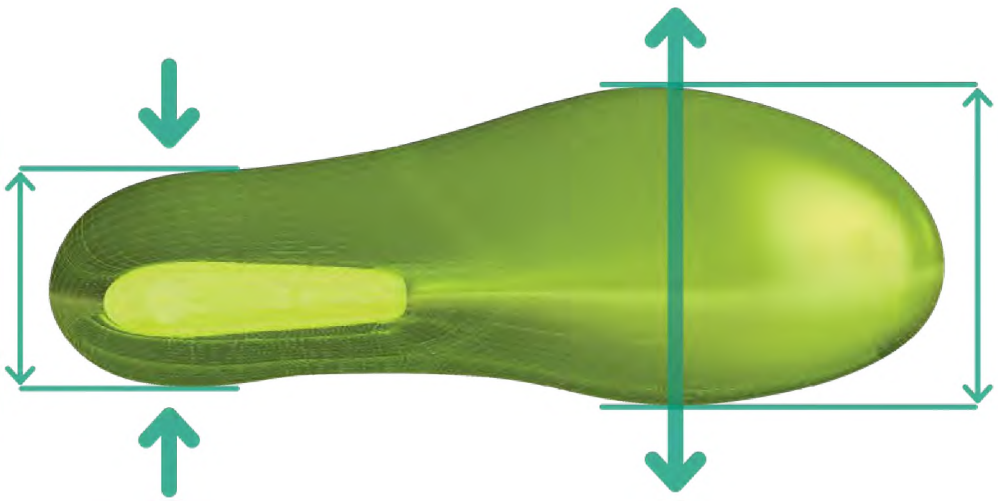
TRAIL COLORWAY		
	19-4405 TCX	FOREST RIVER
	15-4305 TCX	QUARRY
	19-5217 TCX	STORM
	16-5425 TCX	POOL GREEN
	18-1856 TCX	VIRTUAL PINK

FINAL DESIGN INTENT

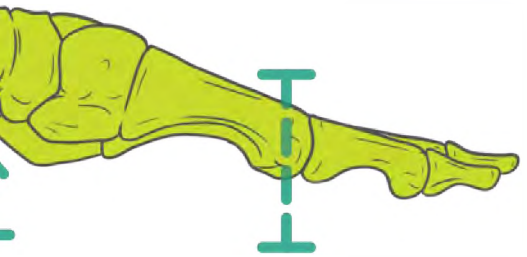
DEVELOPING A FEMALE

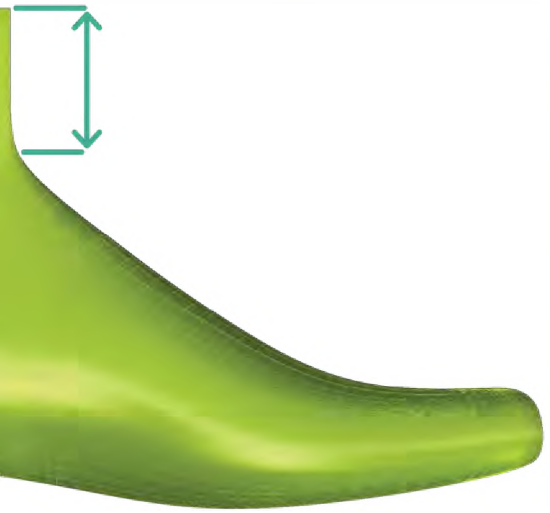






-SPECIFIC LAST





FEMALE-SPECIFIC UPDATES

FEMALE FEET	NARROWER HEEL SHORTER @ HL TO 5TH MPJ NARROWER BALL OF FOOT WIDTH SHORTER ANKLE LENGTH SHORTER MEDIAL MALLEOUS HEIGHT HIGHER & MORE VARIABLE ARCH SMALLER INSTEP CIRCUMFERENCE
TYPICAL W8	65 MM HEEL BREADTH 90 MM FOREFOOT BREADTH 0 MM LAST HEIGHT
TAU TRAINER	60 MM HEEL BREADTH 94 MM FOREFOOT BREADTH 42 MM LAST HEIGHT

PROTOTYPING

ROAD FINAL DESIGN

PADDED TONGUE WITH CINCH LACES

NOTCHED FOAM FOR EXTRA COMFORT WITHOUT COMPROMISING FLEXIBILITY

CINCH LACES ALLOW QUICK LACING

POLYESTER, KNIT, SPACER MESH

DWR FINISH, EXTENDED WATER GUARD WITH FLEX-NOTCHES

SINGLE-SIDED TONGUE FOR DECREASED DEBRIS ENTRY

ACTIVO-ARCH, INJECTION MOLDED TPU

RAISED PROTRUSIONS

INCREASES LOCKDOWN & ARCH ACTIVATION

IMPULSE INTEGRATION SYSTEM

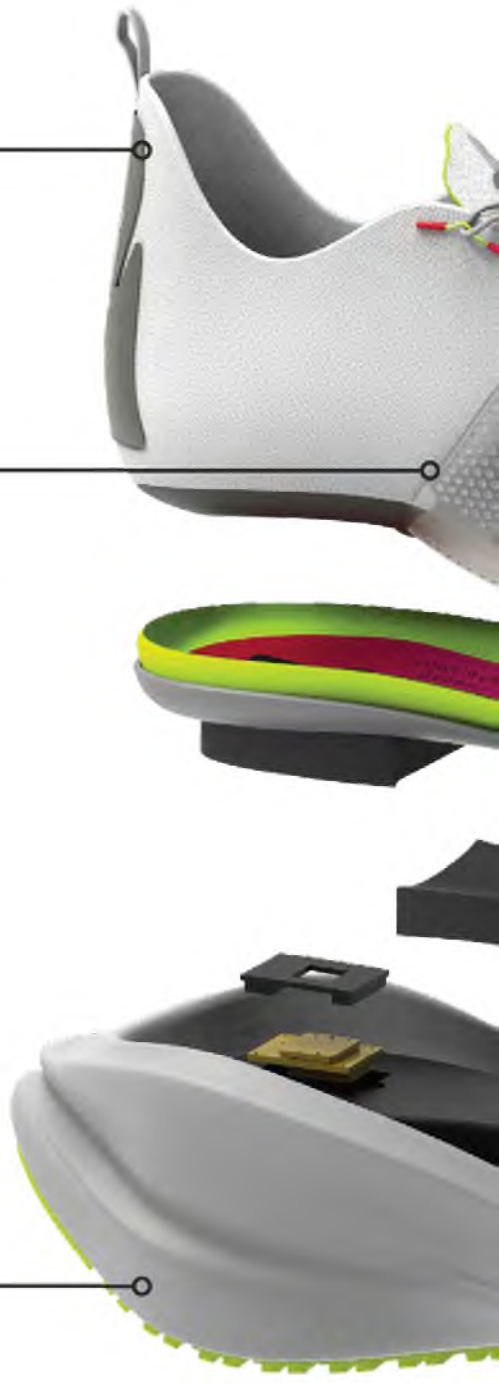
MULTI-LAYER CONSTRUCTION WHICH ENABLES THE QUANTIFICATION OF SHEAR DISPLACEMENT AT THE FOOT-SHOE INTERFACE

RLEAYS INFORMATION TO AN APP VIA BLUETOOTH

EVA FOAM MIDSOLE

HIGH SIDEWALLS FOR INCREASED STABILITY

MAXIMALIST STACK HEIGHT FOR INCREASED IMPACT ATTENUATION



TOTALIS TRACTION, CARBON BLOWN RUBBER OUTSOLE

ENGINEERED FLEX GROOVES & LEADING EDGES FOR MAXIMUM TRACTION ON WET SURFACES

EXTENDED TOE WRAP FOR INCREASED PROTECTION & DURABILITY

TRAIL FINAL DESIGN

PADDED TONGUE WITH CINCH LACES

NOTCHED FOAM FOR EXTRA COMFORT WITHOUT COMPROMISING FLEXIBILITY

CINCH LACES ALLOW QUICK LACING

POLYESTER, KNIT, SPACER MESH

DWR FINISH, EXTENDED WATER GUARD WITH FLEX-NOTCHES

EXTRA TOE-PROTECTION FOR INCREASED DURABILITY

MID-HEIGHT BOOTIE FOR DECREASED DEBRIS ENTRY

ACTIVO-ARCH, INJECTION MOLDED TPU

RAISED PROTRUSIONS

INCREASES LOCKDOWN & ARCH ACTIVATION

IMPULSE INTEGRATION SYSTEM

MULTI-LAYER CONSTRUCTION WHICH ENABLES THE QUANTIFICATION OF SHEAR DISPLACEMENT AT THE FOOT-SHOE INTERFACE

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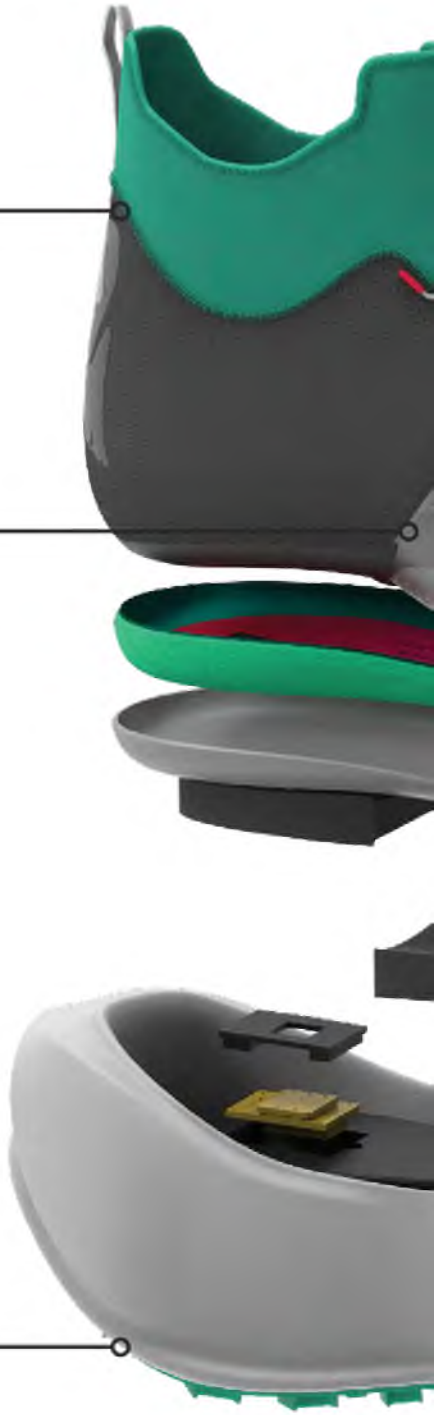
HIGH SIDEWALLS FOR INCREASED STABILITY

MAXIMALIST STACK HEIGHT FOR INCREASED IMPACT ATTENUATION

NARROW FOOTPRINT FOR ENHANCED CONTROL



TOTALIS TRACTION, CARBON BLOWN RUBBER OUTSOLE

MULTI-DIRECTIONAL, 4MM LUGS ENGINEERED TO GRIP THE TRAIL, WET OR DRY

EXTENDED TOE WRAP FOR INCREASED PROTECTION & DURABILITY

FINAL ROAD PROTOTYPE

FINAL TRAIL PROTOTYPE

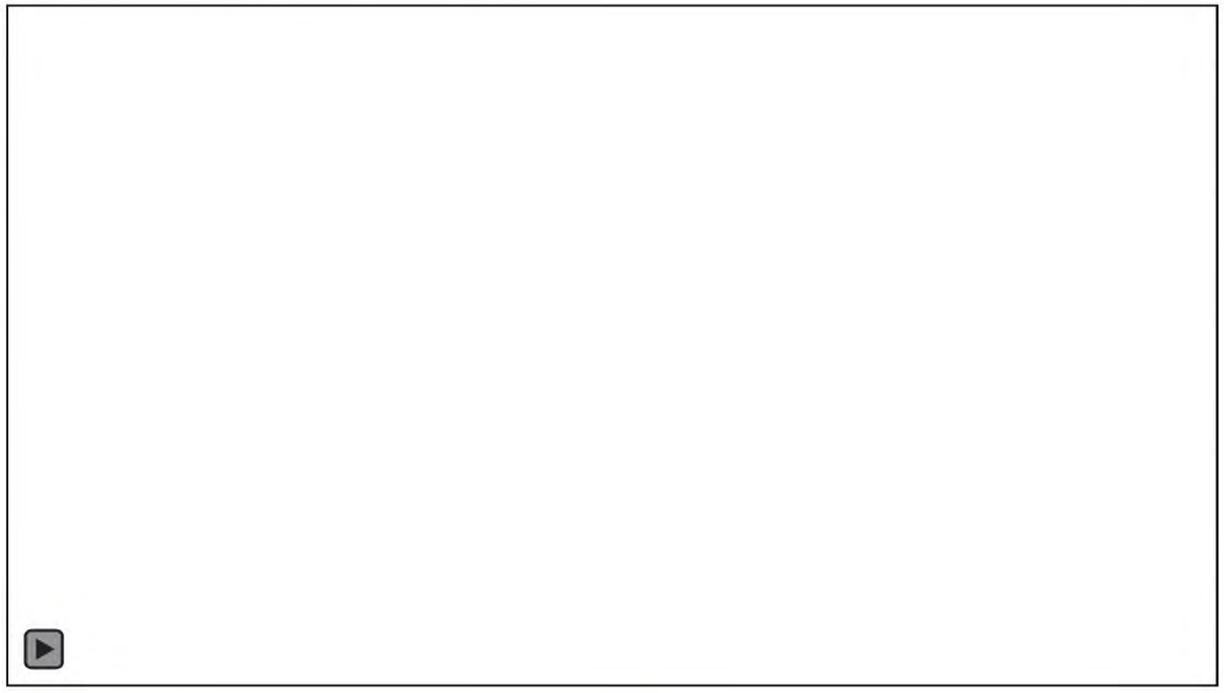
INTERACTING WITH THE APP

ATHLETE & EXPERT VALIDATION

"INTEGRATING SHEAR SENSORS INTO TRAINING FOOTWEAR CAN PROVIDE A DATA-DRIVEN APPROACH TO IMPROVE ATHLETIC PERFORMANCE."

- MICHAEL MCGEEHAN, U.D., BIOMECHANICS & ENGINEERING

	TRACTION	OVERALL*
	8.0 /10	7.0 /10
	7.0 /10	6.9 /10
	9.0 /10	7.3 /10
	8.5 /10	7.5 /10



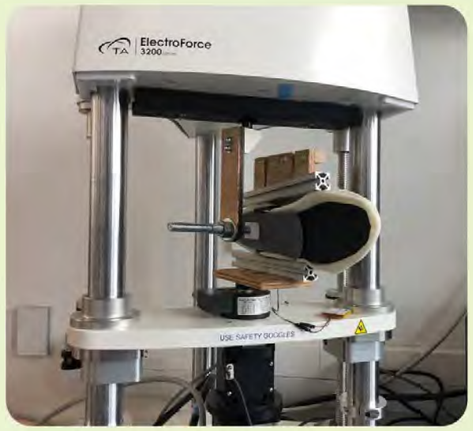
100% OF WEAR TESTERS SAID THE ACTIVO-ARCH TECHNOLOGY PROVIDES EXTRA SUPPORT & LOCKDOWN

"THE SPLIT DESIGN WILL HELP FIT VARIOUS FOOT SHAPES. I THINK THIS WILL IMPROVE LOCKDOWN & HELP ATHLETES FEEL MORE SUPPORTED."

- EVAN DAY, BROOKS RUNNING, RESEARCH SCIENTIST

SENSOR TESTING & VALIDATION

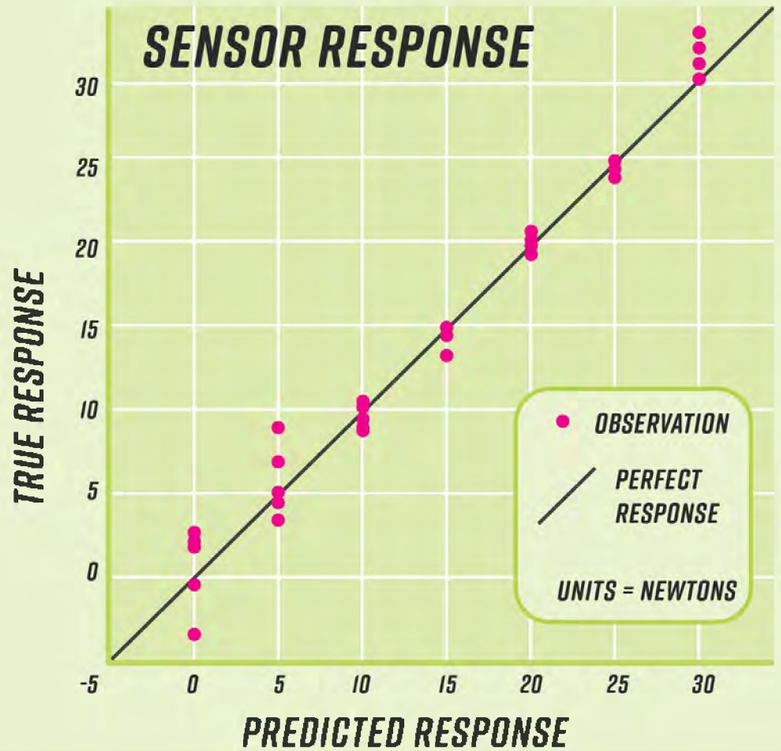
MECHANICAL TESTING



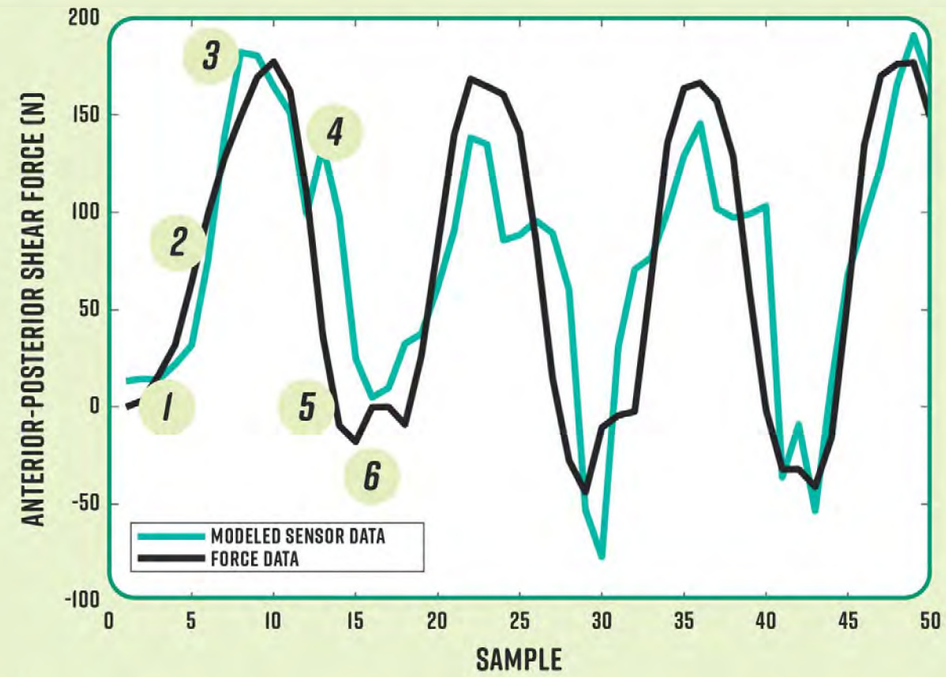
R-SQUARED VALUE

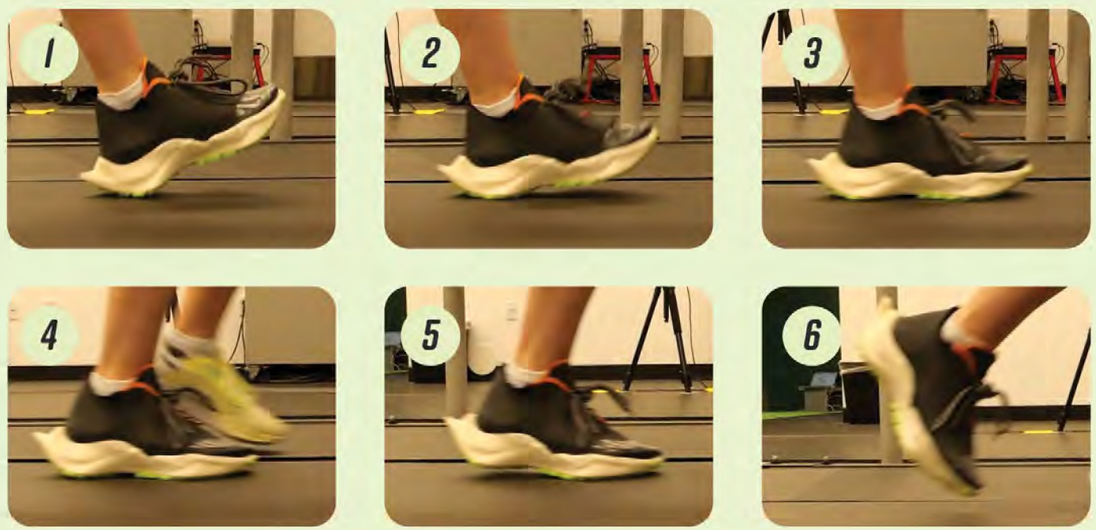
0.98
RMS

>5% ACCEPTABLE % ERROR FROM TARGET (1.0 RMS)



FORCE PLATE WEAR TESTING





QUESTIONS?