

# Research Advances in Fastening and Joining of Engineering Materials

Presentation by

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# FAJRI MISSION

The **mission** of FAJRI is to conduct and sustain innovative research to advance the science and technology in the **four areas** of fastening and joining of materials. This includes both fundamental and applied research, as well as Technology Transfer to the benefit of the mechanical engineering profession and society at large.

FAJRI research areas include:

- 1- Threaded fasteners and bolted joints- with focus on lightweight materials, polymers, composites, ceramics, and medical device (for injured human joints: neck, spine, hip, shoulder, knee).
- 2- Adhesive Joints, including nanomaterial enrichment, damage modeling, failure modes, hybrid joining.
- 3- Welding of low and high strength steels, lightweight materials, composites.
- 4- Advanced riveting of sheet metal and lightweight alloys.

# FAJRI CORE COMPETENCY

## Fastening and Joining of Materials

### (for mechanical, structural, and bio-medical joints)

- OU is the home for the Fastening and Joining Research Institute (FAJRI): a world-wide research icon
- FAJRI is working closely with US Army TARDEC on a variety of vital projects
- FAJRI team has published over 130 peer-reviewed articles and technical reports on fastening and joining
- FAJRI leadership has provided technology transfer workshops and training seminars world-wide
- FAJRI is engaged with NASA, Chrysler, General Dynamics on issues in its area of core competency
- FAJRI helped in bringing a nuclear power plant back on line after a leaky bolted joint caused its shutdown.
- FAJRI leadership is contracted to provide emergency consultations to TARDEC on bolted joint failures in the battlefield (if and when they occur).

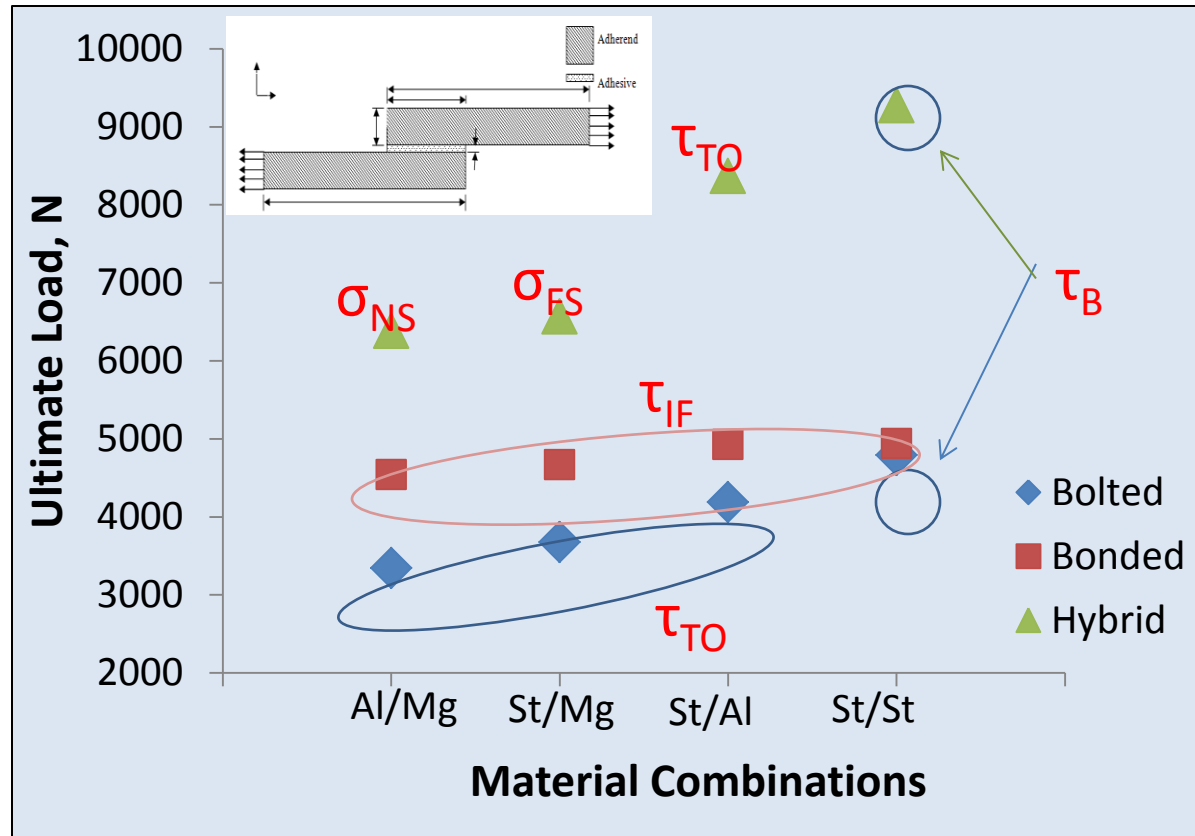
### Recent groundbreaking research at FAJRI includes:

- Preventing vibration-induced loosening of threaded fasteners
- Hybrid bonding-and-bolting of multi-material joints
- Ultrasonic control of bolt tightening by monitoring its elongation in real-time
- Novel torque-tension formulation
- Strain-hardening model for clamp load loss Combined stress model for the nonlinear analysis of clamp loads
- Optical control of bolt tightening and fatigue of bolted joints
- Threaded fastener tribology
- Modeling of gasket creep relaxation
- Effect of elastic interaction on the clamp load in bolted flanges
- Nanoparticle-enriched adhesives for the joining of metals, polymers, ceramics, and composite materials.

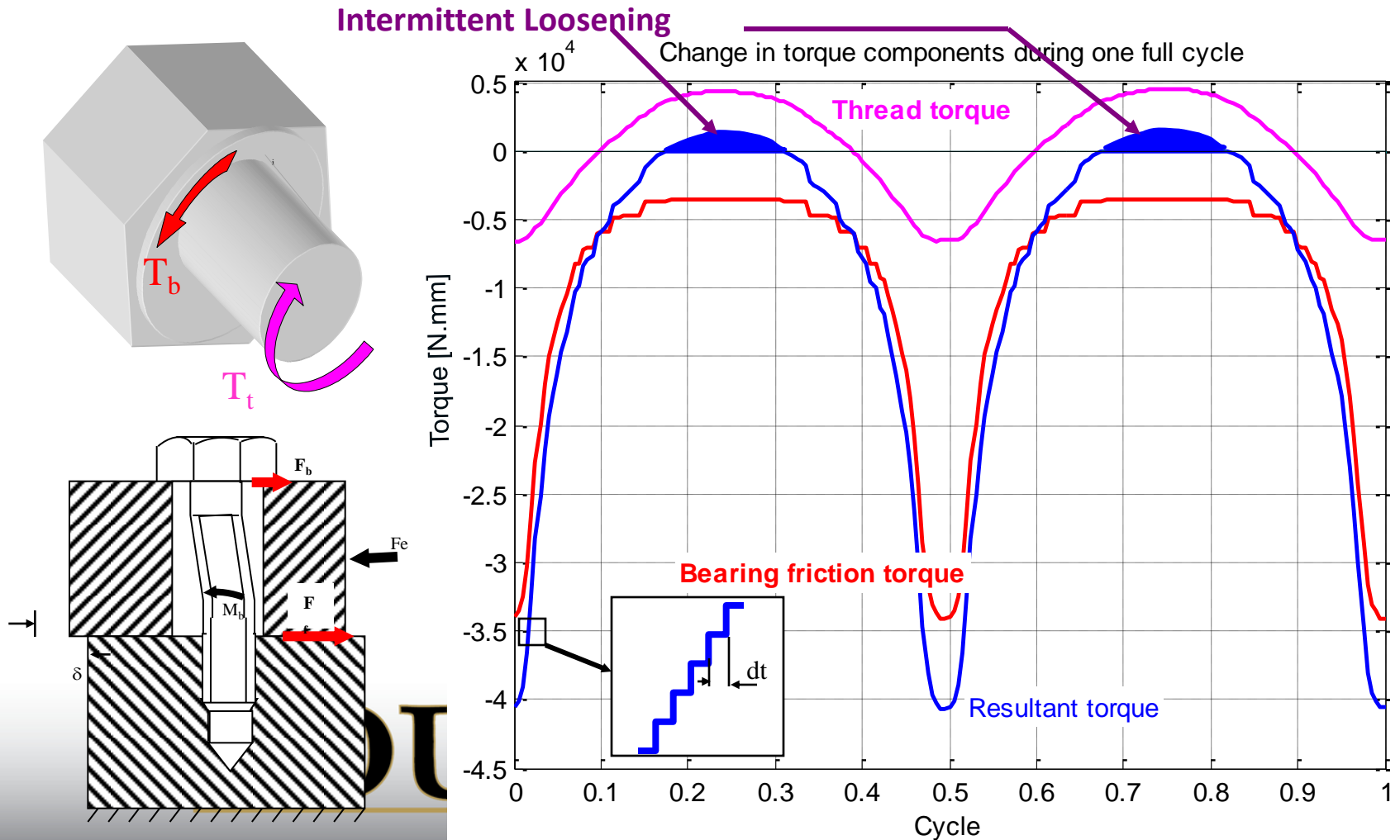
# Joining Method Comparison for Dissimilar Lightweight Joints

## (Ultimate Load & Failure Mode Comparison)

Failure Mode	
$\sigma_{NS}$	al-mg-hybrid25.avi
$\sigma_{FS}$	adhe-high.avi
$\tau_{IF}$	adhe-low.avi
$\tau_{TO}$	al-mg-hybrid75.avi
$\tau_B$	st-st-hybrid.avi



# Bolt Vibration Loosening



# Effect of Thread and Bearing Friction Coefficients (Analytical)

Thread and bearing friction combinations affect the loosening rate

