Industry 4.0: Importance to Indian Footwear Industry
Dear Doyens and Members of the Indian Leather Fraternity: Colleagues from CSIR, Colleagues and Friends! It gives us great pleasure in sending you our September 2019 edition of The LEATHER POST.

I am happy to announce to the members of the Leather Fraternity that CLRI-Centre for Analysis, Testing, Evaluation and Reporting Services (CATERS) is now (12 Sep onwards) an ISO 17025:2017 accredited laboratory for testing in the areas of chemical and mechanical testing. NABL was the accrediting agency.

This edition of the LEATHER POST carries cover article on Industry 4.0: Importance to Indian Footwear Industry. Our R&D efforts combined with Gait Analysis is reaching out far and beyond and CSIR-CLRI is able to assist the discerning with a humane touch!

We at CSIR-CLRI will strive to make this magazine informative and interesting and welcome your feedback for improvement.

24th September 2019

Prof Santosh Kapuria, Director, CSIR-CLRI participated in the 165th meeting of Committee of Administration of the Council for Leather Exports held in Mumbai on 8th August 2019. Major issues concerning Leather and Leather Products were discussed.

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THE SECOND lecture, in memory of two former Directors of CSIR-CLRI – Prof. M Santappa and Dr KV Raghavan, will be delivered by Prof. M S Ananth, Former Director IIT Madras, at the Triple Helix Auditorium of CSIR-CLRI on 3 October 2019.

Prof. MS Ananth graduated from the AC College of Technology in 1967 with a gold medal in Chemical Engineering, obtained his Ph.D degree in the area of Molecular Thermodynamics from the University of Florida, USA in 1972 and joined IIT Madras as a faculty member in the same year. A leading research, gifted teacher and visionary leader of higher education in India, Prof Ananth created the largest open-courseware programme in technical education in the world, the National Programme on Technology Enhanced Learning (NPTEL) and established the first university based research park in India, the IITM Research Park in 2010 to promote innovation and entrepreneurship.

Prof. Ananth has been a Member of both the Scientific Advisory Committee to Cabinet and the National Manufacturing Competitiveness Council from 2007-2011. He participated in the World Economic Forum as a member of the Global University Leaders Forum from 2007 to 2011. He was a Visiting Professor in IIT Kanpur, IIT Bombay and IISc Bangalore, Princeton University and University of Colorado (USA) and RWTH, Aachen (Germany) and a Visiting Scientist in Aspen Tech and in the National Institute of Standards and Technology (USA).

The Lecture
The lecture is titled The Idea of a University.
Abstract: The university today is built on the ideas of the renaissance thinkers who made three basic assumptions: the lawfulness of the material world, the intrinsic unity of knowledge and the potential for indefinite human progress. They believed that the underlying unity in the diversity around us can be unraveled only by scientific inquiry across both the natural sciences (including medicine and engineering) and the humanities. It was von Humboldt in the nineteenth century who advocated the present model of the research university: while research brings passion to teaching, the latter rejuvenates the researcher and the two should therefore go hand-in-hand in the university. Traditionally, the major activities of the University have been teaching and learning and research. In the global knowledge economy of today, governments expect the university, inter alia, to help increase the gross enrolment ratio (GER) and to encourage innovation and entrepreneurship. In this talk we review the traditional activities and discuss briefly the universities’ response to this expectation.
1. Concept

The first industrial revolution used water and steam to facilitate mechanized production. The second was the mass production of electrical power. The third gave birth to electronic-driven information technology such as telecommunications and micro-processing. The fourth industrial revolution or Industry 4.0, is the current era when electronics and information technology enable complete digital connectivity by bringing together the physical, digital, and organic elements of modern human life.

Industry 4.0 is the concept of transforming the manufacturing, more smart and efficient by suitably employing computers and automated systems compounded with intelligent way of data transfer, strengthened by machine learning. Leather product manufacturing, particularly the manufacturing of footwear is associated with flow of data and information significantly across the line of production. Moreover, the man machine interaction is much crucial. This provides ample scope for development of systems, tools and mechanisms based on cyber physical systems (CPS), Internet of Things (IoT), Internet of systems (IoS), automation and intelligent machines. The eventual objective is to develop and provide the knowledge base required for making the leather product manufacturing smart.

2. Industry overview

2.1 World Footwear Production

Footwear production worldwide reached 24.2 billion pairs in 2018, grown by 2.7% over the previous year’s performance. Asian countries led by China still take the top 4 places and 7 out of the 10 spots. Although China remains the undisputed leader of the industry, its production share fell by 2 percentage points last year, whilst India’s, Vietnam’s and Indonesia’s all rose.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Pairs (Millions)</th>
<th>World Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>China</td>
<td>13478</td>
<td>55.8%</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>2579</td>
<td>10.7%</td>
</tr>
<tr>
<td>3</td>
<td>Vietnam</td>
<td>1300</td>
<td>5.4%</td>
</tr>
<tr>
<td>4</td>
<td>Indonesia</td>
<td>1271</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

Top Footwear Producers (Quantity) 2018

2.2 World Footwear Consumption

Asia now buys most of the shoes sold around the world. Asia’s share of total world consumption has increased by 5 percentage points since 2010, Africa’s by 4. Per capita consumption varies between 5.6 pairs in North America and 1.7 in Africa.
The Leather Post

Top Footwear Consumers (Quantity) 2018

The top footwear consumer countries, corresponding to 54% of the world population, jointly represent almost 60% of global consumption. China and India, the two most populous countries in the world.

2.3 World Footwear Exports

Asia is the origin of more than 4 out of every 5 pairs of shoes exported worldwide. The remaining continents together account for less than 3% of the market. China is the origin of almost two thirds of all footwear exports.

2.4 World Footwear Imports

Europe is the leading continent for footwear imports, accounting for more than one third of total world trade. Asia’s share of world footwear imports is increasing rapidly. At country level, the USA continues to be the largest importer of footwear worldwide.

2.5 Dynamics of International Trade

Considering the type of footwear, exports of textile footwear increased the most (9.7%), followed by waterproof (7.1%) and leather footwear (5%). Exports of rubber & plastic footwear fell by 1.7%. Footwear exports reached a new maximum of 142 billion dollars. Europe’s share of world exports increased by 6.9 percentage points since 2015. Africa accounts for 18% of the imports of rubber & plastic footwear. All intercontinental trade flows exceeding 0.5% of world trade start in Asia or Europe, other continents being only at the receiving end of international trade.

The growing importance of textile footwear has been the most striking trend over the last decade with regard to the type of footwear being exported. Textile footwear doubled its share in exports in a decade.

2.5.1 Manufacturers in the international market

China is the most important player in the international footwear market, leading the tables of the largest producers, exporters and consumers activities. Spain exports 158% of its production, India only 10%. Nine out of the 20 largest producers have export prices in the $14–$21 range.

2.5.2 Consumers in the international market

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$24 As Chinese imports grow, their average price has been falling
2.5.3 Top 5 Exporters in Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>$ (millions)</th>
<th>Continent share</th>
<th>Pairs (millions)</th>
<th>Continent share</th>
<th>Average price</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>44673</td>
<td>53.3%</td>
<td>9543</td>
<td>77.2%</td>
<td>$4.68</td>
</tr>
<tr>
<td>Vietnam</td>
<td>21167</td>
<td>25.3%</td>
<td>1272</td>
<td>10.3%</td>
<td>$16.64</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6774</td>
<td>8.1%</td>
<td>406</td>
<td>3.3%</td>
<td>$16.70</td>
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<tr>
<td>India</td>
<td>293</td>
<td>3.0%</td>
<td>262</td>
<td>2.1%</td>
<td>$9.50</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>2365</td>
<td>2.8%</td>
<td>131</td>
<td>1.1%</td>
<td>$18.03</td>
</tr>
</tbody>
</table>

*Top Exporters in Asia 2018*

China’s share of Asian exports fell 5 percentage points in 2018

2.5.4 Top Exporters By Product Type

India is not in the top 10 exporters of water proof leather, textile footwear and footwear made out of rubber and plastics. Exports of textile footwear are growing the most. Leather footwear exports are geographically less concentrated than other types. China leads but its value share continued to fall last year

<table>
<thead>
<tr>
<th>Country</th>
<th>$ (millions)</th>
<th>Continent share</th>
<th>Pairs (millions)</th>
<th>Continent share</th>
<th>Average price</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>9079</td>
<td>16.5%</td>
<td>644</td>
<td>30.2%</td>
<td>$14.10</td>
</tr>
<tr>
<td>Italy</td>
<td>8104</td>
<td>14.7%</td>
<td>110</td>
<td>5.2%</td>
<td>$73.62</td>
</tr>
<tr>
<td>Vietnam</td>
<td>6421</td>
<td>11.7%</td>
<td>294</td>
<td>13.8%</td>
<td>$21.83</td>
</tr>
<tr>
<td>Germany</td>
<td>3662</td>
<td>6.6%</td>
<td>89</td>
<td>4.2%</td>
<td>$41.13</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2552</td>
<td>4.6%</td>
<td>131</td>
<td>6.1%</td>
<td>$19.55</td>
</tr>
<tr>
<td>France</td>
<td>2048</td>
<td>3.7%</td>
<td>28</td>
<td>1.3%</td>
<td>$73.60</td>
</tr>
<tr>
<td>Belgium</td>
<td>2012</td>
<td>3.7%</td>
<td>59</td>
<td>2.7%</td>
<td>$34.30</td>
</tr>
<tr>
<td>Portugal</td>
<td>1981</td>
<td>3.6%</td>
<td>58</td>
<td>2.7%</td>
<td>$34.09</td>
</tr>
<tr>
<td>India</td>
<td>1943</td>
<td>3.5%</td>
<td>127</td>
<td>5.9%</td>
<td>$15.38</td>
</tr>
<tr>
<td>Nether-lands</td>
<td>1830</td>
<td>3.3%</td>
<td>48</td>
<td>2.2%</td>
<td>$38.15</td>
</tr>
</tbody>
</table>

*Top 10 Exporters of Leather Footwear 2018*

The Indian footwear industry is associated with the following weaknesses.
- Low level of modernization and technology upgradation
- Low level & labour productivity
- Horizontal growth of tanneries
- Less number of organized product manufacturers
- Environment of inadequate hygiene
- Low level & awareness and conformity to International standards.

The opportunities ahead of the Indian footwear industry are as follows
- Use of information technology and decision making software to reduce length of production cycle.
- Product diversification
- Growing international and domestic market

Therefore, it is conspicuous that the concept of industry 4.0 will be of immense benefit to enhance the productivity and level of conformance to the requirements.

Hence, it is proposed under this project to design develop and validate systems, tools, techniques, mechanisms and software for enabling the Indian footwear industry opting for industry 4.0.
3. Strategy

One of the key objectives of Industry 4.0 is to combine two principles that are actually opposites, strictly speaking – production line manufacturing and custom manufacturing in a smart environment referred to as smart factory. The concept of a smart factory makes the rather abstract idea of Industry 4.0 easier. This is where the Internet of Things comes into play, i.e. nonhuman parties communicating with each other. That could be a plant sending out a signal that it needs new material and the smart factory automatically and independently forwarding this information. The communication between these ‘entities’ takes place through appropriate electronic networking in a smart way. This is the core point about Industry 4.0 – the Process Knowledge Automation. The Process Knowledge Automation resolves and enables the problem that work-pieces don’t have the technical capabilities to communicate on their own transforming physical systems into ‘cyber physical systems’ (CPS), whereby the work-piece is the physical element and the Knowledge Automation is the digital element. The role of humans in CPPS (Cyber-Physical Production Systems), however, should not be disregarded.

Efficient Production planning and control for footwear production

Production planning is one of the important business processes of manufacturing industry. Effective production planning engenders production of products meeting the requirements with the optimum level of consumption of resources. Production planning gets complicated, where the product mix is heterogeneous. The production-planning problem can be modeled using discrete optimization techniques, in particular MIP (Mixed Integer Programming) and CP (Constraint Programming). Two main decisions need to be taken for each task of each production order - who will perform it and when. In order to take this decisions, multiple and complex constraints must be considered, some representing technological constraints and some related to supply chain aspects. Finally, multiple objectives must be pursued, mainly - minimizing delayed deliveries and optimize the usage of the available resources.

Smart Inventory management for footwear unit

Inventory management is firmly entering the Industry 4.0 era, with smart, connected technology changing the nature of the entire value chain in terms of visibility and data usability. As inventory management undergoes this transformation alongside Industry 4.0 processes that are more strictly industrial (e.g. production planning), what should supply chain managers in the manufacturing sector know in order to prepare for future changes?
Using AI for inventory management can help to avoid poor decisions, as well as inform new investments. However, this improvement won’t happen overnight. The success of this software will rely heavily on high data granularity, and businesses need to make sure they are building AI readiness now. Granularity is used to characterize the scale or level of detail in a set of data, of which AI is highly dependent on. The greater the granularity, the deeper the level of detail across the data.

**Effective Maintenance management for footwear unit**

There are a lot of complex systems used in Industry 4.0, both for technology and people. The habits, processes and tools of a well-built preventive maintenance program increase the chances of successfully transitioning to Industry 4.0. There are eight steps to creating a solid preventive maintenance program. Everything from defining the goals to getting the right technology and measuring success. This process will help to fine-tune the maintenance practices while giving the know-how to build and implement a strategy for Industry 4.0 with fewer hiccups.

Data is the cornerstone of Industry 4.0. Advanced technology can’t do its job without detailed, accurate information. Having lots of high-quality data makes it easier to use the systems of Industry 4.0 to their full potential. The time is now to start building that inventory of intelligence.

Industry 4.0 is a big change, and change is never easy. That’s why implementing new technology starts with people. Not only do we have to do an exceptional job at training and organizing maintenance staff, but we must also prepare them for the changes that will come with new systems and processes.

**Profitable personnel management for footwear unit**

Management practices can lead to the compatibility with industry 4.0. As these practices provide an environment and climate, suitable for learning new skills to meet the requirements and challenges of industry 4.0. Learning and knowledge management increases the capability of the employees by making them more creative and innovative. More creative and innovative employees will be in better position to contribute in smart manufacturing and business operations, which are the main characteristics of industry 4.0, and innovation capability is one of the main factors needed for success in industry 4.0. In this way appropriate management practices can make the organization compatible with industry 4.0.
4. Conclusion
As increased attention is given to Industry 4.0, intelligent manufacturing is becoming more and more important in the advancement of modern industry and economy. Intelligent manufacturing is considered to be a key future perspective in both research and application, as it provides added value to various products and systems by applying cutting-edge technologies to traditional products in manufacturing and services. Product service systems will continue to replace traditional product types. The aim is that companies by effectively implementing Industry 4.0 significantly improve their competitive position, increasing value creation and minimizing risks, with the adoption of more efficient and faster production systems and innovative technologies. Amongst the main envisaged benefits are shorter operations cycle times, quick delivery times, faster time to market of new products and services, improved quality, and product/service customization, while involving the consumer in a more proactive and intense way. They can address new and emerging markets by a differentiation strategy, or even create new disruptive business models. However, Industry 4.0 is still in the early stages for most companies and the digital transformation will require a strong leadership, the right human competences and to overcome the several barriers identified for its successful implementation.

India is the second largest producers of footwear and garments in the world. India produces about 2579 million pair, accounting for about 10.7% of the global production. Indian footwear industry employs about 1.1 million workers. About 90% of the footwear produced in India is consumed by domestic market and the rest exported. India exported US$ 293 million worth of footwear (2018). The global footwear market is valued at about US$ 208 billion and expected to reach US$ 258 billion by 2023. Adoption of industry 4.0 is an important way to realise these targets.

“Leather & Banana Fabric Combination Collection”

LEATHER & BANANA FABRIC COMBINATION COLLECTION

The Leather Post
“Faster cutting with new styles and modifications made quickly and easily”

CSIR-CLRI Shoe & Product Design Centre re-introduces die-less cutting system in its ‘new & modern infrastructure’

ZUND/NESTOR DIE LESS CUTTING SYSTEM

CSIR-CLRI, in keeping with its norm of being always a step ahead and bringing for the Indian Leather and Leather Product Manufacturers the latest technological innovation had procured and installed the ZUND/NESTOR Die Less Cutting system in March 2012.

The Die less cutting system is a continuous cutting system used for cutting Leather, Synthetics, Insole Boards, Sole Bends, Plastic Sheets for Marking Patterns as well as all types of Soling Material Sheets.

With this method, it is possible to produce faster with new styles and to make modifications quickly and easily through a direct interface with the CAD software with the data being fed directly.

System features:
- The system is for low to medium volume production and the table has a cutting area of 1040 x 2480 mm, which is split in to two working regions with each region having a fixed projector for projecting the patterns to be cut on to the cutting material.
- Both the tables are inclined to make it easier to see the leather and to place the pieces.
- It has an oscillating knife, marker pen and punch tools.
- The projection systems used on the leather cutting tables are of high luminosity to give a clear view to the operator.
- It can be used for cutting Leather, Insole board, Hard materials and Synthetic materials.
Software:
• It provides interactive nesting features, leather scanning and digitising and multiple table support functionalities.
• The well designed graphic interface with grouped functions and movable control boxes reduces the time required for executing cutting jobs.
• The Interactive nesting comes with real time overlapping control, minimum gap definition and piece adjustment.
• The software options provide for Optimised piece presentation order with different strategies and piece grouping.
• There is a provision for storing and recalling existing styles as well as nesting layouts.
• The Cutting features include Tool-path optimisation as well as storing the Cutting parameters for recall without recalibrating every time.

Benefits:
One can start cutting immediately.
• No need to invest in expensive dies.
• Speed up sample production.
• Produce low quantity orders that are too complicated to hand cut.
• Reduce leather costs by reducing wastage.
• Use interactive nesting to give consistent high yields of leather usage.

The keys to its success are principally:
• The Productivity and Accuracy
• The Reliability
• The Interactive Nesting on skins
• The Projection system
• The Cutting Head with multi-tools
• The Vacuum system
• The simple and powerful Software

OUTPUTS:
• Cutting of all types of Leathers of varying substance
• Cutting of Synthetic materials of varying thickness
• Cutting of Insole Boards
• Cutting of Sole Bends
• Cutting of thick Plastic sheets for Marking Patterns
• Cutting of all types of Soling Material Sheets

The ZUND/NESTOR Die Less Cutting system will be re-dedicated for the benefit of the Indian Leather and Leather Product manufacturers at the newly commissioned ‘Design Innovation Centre’ at the Shoe and Product Design Centre (SPDC), CSIR-CLRI on 10th October 2019.

For further details, please contact: spdc@clri.res.in

(In picture: Working Team from Shoe & Product Design Centre making the trials before the re-launch)
The scope of CHD17 is to formulate Indian Standard for terminology, method of sampling and test, codes of practice and specifications for leather, leather products (excluding leather footwear), tanning materials, and allied products, leather machinery, tools and equipment for leather and leather goods industry (other than shoe makers) and assessment and grading of hides, skins and leather. CSIR-CLRI is the host national body for the CHD17.

The meeting looked at the attendance of a few industrial association representatives and requested them to attend the meetings regularly so that the specifications for various leather and leather products could be revised effectively. Amongst the various recommendations, the committee recommended to revise the standard IS 14898:2001 – Eco criteria for finished leather to be in tune with emerging trends in the sector. While revising the specifications for IS 8517:1977, specifications for bag, air travel and IS 10845:1984, specifications for bag, pilot, the committee sought to understand from the industry whether there was a need for such standards. Methods for chemical testing of leather – IS 582 has been harmonized with the corresponding ISO methods, which is expected to ensure that Indian test methods are in tune with international standards.

The committee congratulated the chairmen of the ISO TC 120 working group on Vocabulary from India, viz., Dr S Sadulla and Dr C Muralidharan for having successfully completed the Leather Vocabulary international standards – ISO 15115. Similarly, the business plan for ISO TC 120 as provided by India has also been published. Indian team from CSIR-CLRI would also be coming out with draft documents for various standards and guidelines such as a) Framework for sustainable manufacture of leather, b) Traceability of hides and skins, c) Leather – upholstery leather characteristics – selection of leather for furniture, d) guidelines for classification and identification of leather product and e) guidelines for identification of processed and semi-processed leathers.

The meeting ended with the Chairman thanking all the participants and also requesting those who have been assigned the tasks of coming out with standards/guidelines to ensure that the timelines are maintained.
CSIR-CLRI has been rendering assistance to the industry, government agencies and regulatory bodies for their quality testing and assurance programs. Since 1995, the Shoe and Allied Trades Research Association (SATRA), UK has been carrying out competency checks and audits for the capability of the testing service staff to perform the tests in accordance with the test methods.

Through the last decade, the proficiency and ability of a laboratory to carry out testing activities and produce precise, accurate test data is verified as per ISO 17025. The laboratory audit by third party independent and experienced assessors by the national body - National Accreditation Board for Testing and Calibration Laboratories (NABL) as per ISO 17025:2017 provides for authentication of

- Traceability of measurements to national standards
- Technical competence of the staff
- Maintenance of test equipment
- Quality assurance as per international standards
- Validity and appropriateness of the test methods employed
- Standards of test sample handling
- Quality of testing environment
- Impartiality, confidentiality and integrity of the laboratory and its staff

The system for quality assurance for the testing services carried out by the institute through the CLRI-CATERS reflected through a Quality Manual, 13 Quality procedure documents, 20 Quality forms, 28 Quality records and 33 standard operating methods have been adequately audited by the assessors nominated by NABL. The competence of the laboratory to perform tests for leather, leather products, footwear, textile, rubber and plastics have been verified.

The scope of accreditation covers 176 physical tests and 49 Chemical tests (for more details visit our website: testing.clri.org)
A nine-year-old boy who is walking with difficulty from childhood visited CLRI gait analysis laboratory, Shoe and product design centre (SPDC) on 28, August 2019 along with his mother as referred by paediatric orthopaedist, Department of orthopaedics, All India Institute of Medical Sciences (AIIMS), New Delhi to perform gait analysis and obtain the report.

Below analysis were done for the boy to understand the abnormal gait and prepare the gait analysis report.

- Visual assessment;
- Body composition analysis;
- Plantar pressure analysis and
- 3D gait analysis including kinematics, kinetics and Electromyography (EMG) analysis.

From the visual assessment below abnormalities are observed.
- The boy is having severe abnormal gait;
- The contraction of hamstring muscle (thigh muscle) is more;
- Not able to contract gastrocnemius (calf) muscles;
- Pelvic and knee instability (not able to do full range of Pelvic and Knee extension);
- Balancing the posture and gait with shoulder and trunk (body) forward bending;
- Normal movements in ankle joint is poor;
- Therefore, the boy is walking with slap gait (the foot to slap down on the floor with each step) maintaining knee in the flexed position.
- Both the foot has fallen arches
From the 3D gait analysis (3DGA), the standing angles and range of motion of joints for hip, knee and ankle joints are measured quantitatively on quite bipedal standing and walking respectively.

➢ The standing angles of hip and knee flexion is shown in 3DGA as significantly higher than the normal degree of angles.

➢ The joint range of motion of hip follow the pattern of normal gait cycle but with more flexion and less extension degree. So there is scope for gait correction by stretching the muscles responsible for hip flexion and extension.

➢ Knee is maintained in flexion position throughout the gait cycle due to over contraction of thigh muscles and weak calf muscles.

➢ Foot is rotated internally during the end of stance phase (foot on floor) and to prepare for swing phase (foot in air).

➢ Presence of low range of ankle movements is observed in 3DGA and shows the scope for improvement by physical therapy and exercises related to foot and ankle movements. With the improvements in the foot movements the gait can be improved and the further gait complications and foot deformities can be prevented.

➢ EMG analysis has also confirmed the continuous contraction of thigh muscles during walking and very low contraction of calf muscles.

➢ With this insight about the gait of the patient, the treatment program by physical therapy can be designed to improve the gait and to prevent further lower limb complications.

To better understand the movements of lower limb joints during walking, 3D gait analysis was performed which will provide joints range of motion in hip, knee and ankle during one gait cycle for both left and right limbs. From the gait analysis report, the physician will get more insight about the gait abnormality of boy and to design treatment program by physical and clinical methods.

From the plantar (Foot) pressure analysis, it is observed that

➢ Plantar Pressure distribution is asymmetric between left and right during quite standing;

➢ Increased maximum pressure distribution is observed on the right foot than the left foot during quite standing;

➢ Foot contact area is comparatively lesser in right than the left foot;

➢ Peak plantar pressure is observed at the metatarsal region (M1 & M2) in both the foot;

➢ Static foot arch index indicated flat foot in both left and right foot.

➢ Peak plantar pressure is noted on great toe region on both the foot while walking with self-selected speed of walking.

➢ Right foot pressure at great toe is significantly more than the left foot.

➢ The center of path of pressure (COP) pattern of foot travels from midfoot to great toe/ second toe.

From the analysis using inertial sensors, spatiotemporal parameters such as step length, step width, stride length, gait cycle time, speed, velocity and pelvic movements are measured.

• All spatiotemporal parameters are found to be not meeting the normal values.

• More anterior pelvic tilt is noted.
Fifty years old woman from Visakhapatnam, Andhra Pradesh with the following medical history visited CLRI gait analysis laboratory, Shoe and product design centre (SPDC) on 21, August 2019 as referred by her Physiotherapist.

- Met with an accident at the age 19 and resulted in left pelvic fracture, right ankle hairline fracture. Arch correction footwear was used for about 3-4 months;
- Had a hysterectomy at the age of 30;
- Since the age 40 onwards chronic pain at the right knee joint;
- Past 10 years, right ankle is painful and sometimes swells up (continues till date);
- In 2017 March had a total knee replacement surgery; after the knee surgery the swelling at ankle joint got reduced;
- For past one year the person is again suffering from ankle pain and swelling; For past six months again suffering from pain in the knee, especially while getting up from a seated position, walking etc. and unable to bear weight on the right knee (artificial knee).
Below analysis are done for the woman to understand the cause of pain and prepare the gait analysis report.

1. Visual/Physical Assessment
2. Plantar pressure analysis (a) Static (b) Dynamic
3. G-Sensor analysis
4. Instrumental treadmill analysis

From the visual and physical assessment below abnormalities are observed.

- Slight Abnormal Standing Posture
- Hip hike at right side
- Pelvic tilt
- Knee valgus (Knocked knee)
- Limb length discrepancy (Left limb is shorter than right limb by 2 cm)
- Swelling at ankle joints; right side is more than the left
- Foot Pronation in both side; Heel (rear foot) valgus at both sides.

Results of Gait analysis

Plantar pressure analysis
- Plantar Pressure distribution is asymmetric between left and right during quite standing.
- Peak plantar (Foot) pressure is observed at medial heel region due to over pronation in right foot and at first meta tarsal region (101.1 kPa) in left foot which is quite abnormal in standing posture.
- Peak pressure is noted at great toe region (T1) in right foot and at Metatarsal region (M1) and great toe region (T1) in left foot in normal walking. Significant difference in pressure values between left and right foot is observed. Plantar pressure is more in right foot than in left foot though the foot contact area is more in right foot than the left.
- The center of path of pressure (COP) pattern of left foot starts from rear of the heel region and travels through midline of mid-foot and exits between great toe and 2nd toe with more time of contact in mid-foot in both the foot.

Inertial sensor analysis
- The spatiotemporal parameters are asymmetric between left and right leg.
- Though the stride length is same for left and right leg, discrepancy in step length, stance phase and swing phase duration is observed between left and right leg.
- Significant difference in step length (Left is more; Right is less), swing phase duration (Left is more; Right is less), stance phase duration (Left is less; Right is more) between left and right leg is observed.
- Significant difference in single support phase duration between left and right leg confirms the lower limb musculoskeletal problem due to the limb length discrepancy.

Instrumented Treadmill analysis
- Force is more at forefoot region in left foot and in rear foot region in right foot.
- Asymmetry in step length between left and right is observed; Right side is more than the left.
- Cadence (Number of steps per minute) is less than the normal.
- Maximum force is higher in left leg than right leg may be due to pain in right knee.
- Significant difference in time change from heel to forefoot is observed between left and right foot. Right side is more than the left side. It can be seen in COP butterfly diagram in the report.

Final Impression from the gait analysis
- Asymmetric plantar pressure distribution during quiet standing.
- Peak pressure on right great toe is abnormal during normal walking.
- Discrepancy in limb length (distance between the anterior superior iliac spine (ASIS) to the medial malleolus) was observed. The right leg is longer than the left by 20 mm which could be the probable cause of the abnormal posture and gait related problems from the age of 40 and lead to chronic pain in right knee due to over loading and compensatory gait (walking pattern)
- Functional foot deformity in both the foot due to abnormal/compensatory gait to manage pain and overweight.
- Asymmetric Pelvic obliquity and rotation is observed; more at left side.
- Asymmetric distribution of force between left and right leg; Force is more at forefoot region in left foot and in rear foot region in right foot.
- With this insight about the gait of the patient, the treatment program by physical therapy can be designed to treat the pain and to prevent further lower limb complications.

Footwear Recommendation:
It is recommended to the patient for the use of prescribed footwear with following features:
- Sole correction in left footwear to compensate the shorter leg
- Arch support with sufficient height to support the arch to increase the foot contact area to distribute the pressure from peak sites
- Upper with therapeutic features to control over pronation and heel valgus.
"Sports Shoes for the Indian Athletes"

Anthropometric Measurements being done jointly by Team CSIR-CLRI & Tamil Nadu Physical Education and Sports University

Anthropometric measurements orientation held at Tamil Nadu Physical Education and Sports University (TNPESU) at the Department of Sports Biomechanics and subsequent “foot scanning” of the sports persons at TNPESU
Team from Shoe and Product Design Centre (SPDC), CSIR – Central Leather Research Institute (CLRI) comprised Mr. D. Suresh kumar, Scientist, Mr. M. Akshayaraman, Scientist, Mr N Govindarajan, Principal Technical Officer; Mr. R. Sathiyaraj, Technical Assistant, Ms. S. Preethi, Senior Research Fellow, Mr. Madhusudhanan Pillai, Project Assistant have visited Tamil Nadu Physical Education and Sports University (TNPESU), Melakottaiyur, Chennai during the first week of August regarding the Questionnaire and anthropometric survey of athletes under the guidance of Dr. (Smt) G. Saraswathy, Senior Scientist, SPDC, CSIR- CLRI.

Prof. Grace Helina, Head, Department of Exercise Physiology and Biomechanics, TNPESU has organized the necessary arrangements to provide orientation to the team CLRI and to conduct the survey with athletes of age group between 18 to 24 years. Dr. R. Venkatesan and Dr. P.K. Senthil kumar, Department of exercise physiology and Nutrition, Prof. Rajini Kumar and Mr. Mohan Doss, Visiting Faculty, Department of Biomechanics, are also involved in the study and supported the CLRI team to start and continue the survey at TNPESU campus with 430 athletes during August 2019. The present study and survey are part of the proposed collaborative project titled “Design and development of athletic shoes for Indian Athletes” between CSIR-Central Leather Research Institute (CLRI) and Tamil Nadu Physical Education and Sports University (TNPESU), Melakottaiyur, Chennai.

Orientation about anthropometric measurements by Dr. Senthil kumar, Department of exercise physiology and biomechanics

The initial phase of the project included the anthropometric measurements of whole body including foot because all the sports activities pertaining the movement of the entire body. The specific changes on the body segmental dimensions among Indian athletes will be studied through anthropometric measurements of whole body including foot. It would make the great impact to develop the shoes and accessories for the Indian sports people. Currently available shoes like Nike, Reebok, Adidas etc. are designed by other countries and the biomechanical studies are also from their country sports people. Therefore, this survey can have huge impact to develop the shoes and accessories for the Indian sports people.

Instructions to follow for anthropometric measurements

Dr. Venkatesan explained about the basic requirements for the survey program to be conducted with athletes. Three teams comprising minimum two members in each team (one male and one female) are formed for Questionnaire survey (online data collection using Google doc.), anthropometric measurements using International standard anthropometric kit and foot scanning using 3D laser foot scanner. Each team required persons from both the institutes according to the expertise as tabulated below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Surveying</th>
<th>Anthropometric measurements</th>
<th>Foot scanner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns</td>
<td>CSIR-CLRI</td>
<td>TNPESU</td>
<td>CSIR-CLRI</td>
</tr>
<tr>
<td>persons required</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The training program on anthropometric measurements was conducted by Dr. Senthil Kumar, TNPESU on 02nd and 05th August, 2019 for Team CLRI.

Subject Preparation

- The subjects are requested to come in the minimal clothing for the anthropometric measurements. The clothing worn must be of minimal thickness and it follows the natural contours of the body which helps to measure the accurate values and also access the measurements easily. Exclusive room is provided for anthropometric measurements to provide privacy and comfortable atmosphere (room temperature) for the subject. Measurements are taken by the people of same gender.
- The subjects are instructed about the way they should stand for taking anthropometric measurements.
- The required markings using washable non-toxic marker are made on the subject’s body for the quick and efficient measurements.

Restrictions for the subjects

1. No drugs during the survey.
2. No vigorous exercises before the survey.
3. Complete sleep at the last night.

Anthropometric tools

Weighing scale

The traditional instrument of choice has been the beam balance accurate to the nearest 100 g. However, the use of electronic scales is becoming more general and the accuracy of some of these scales is greater than that of the beam balance. The subject is requested to stand straight with the vision also straight to get most accurate measurement of the weight.

Anthropometric tape

A flexible steel tape of at least 1.5 m in length is recommended for girths. This is calibrated in centimetres with millimetre gradations. Tape which is non-extensible, flexible, and no wider than 7 mm and have a stub (blank area) of at least 4 cm before
the zero line is used. In addition to assessing girth measurements, an anthropometric tape is also required to accurately locate a number of skinfold sites and mark distances from bony landmarks. The tape is enclosed in a case with automatic retraction.

**Small sliding caliper**

This caliper is used for Biepicondylar humerus and femur breadths, as well as other small bone breadths. It has branch lengths of at least 10 cm, an application face width and be accurate. The longer branches allow sufficient depth to encompass the biepicondylar breadth of the femur and humerus.

**Segmometer**

The segmometer is designed to be used as an alternative to the anthropometer although it is not appropriate for measuring large bone breadths.

**Wide spreading caliper**

The wide-spreading caliper is a hinged instrument used mainly to measure anterior-posterior chest depth and other trunk depths. The instrument is of sufficient length to allow the caliper branches to be placed over the shoulder to the anatomical landmarks.

**Demonstration on anthropometric measurements**

**Body mass:** The body mass is measured in minimal clothing is of sufficient accuracy. The scale is checked for reading zero, and then the subject stands on the centre of the scales without support and with the weight distributed evenly on both feet.

**Body height:** Standard criteria for measuring stature free standing is followed; stature against the wall, recumbent length, and stretch stature. The height is noted in cm.

**Length of leg:** A mark is made on the tip of the hip bone and using anthropometric tape measured from the mark of tip of the hip bone to the lateral side of foot arch.

**Length of the arm:** A mark is made on the acromial point of the shoulder bone and using the anthropometric tape measured the length between the acromial point of shoulder to the tip middle finger.

**Circumference of upper arm flexed:** A mark is made on the acromial point of the tip of the shoulder bone to the radial point on flexing region of the arm. Further marked the midpoint of the length and measured the circumference of the midpoint.

**Circumference of mid-calf:** Measured the circumference of maximum girth of the calf, exactly from the flexing of the knee point.

**Circumference of mid-thigh:** By using anthropometric tape measured the distance from the Trochanterion to Tibiale laterale and marked the midpoint of it. Then measured the circumference of the marked point.

**Waist:** Measured the circumference of the end of rib bone by using anthropometric tape.

**Hip:** The girth is taken at the level of the greatest posterior protuberance of the buttocks which usually corresponds anteriorly to about the level of the symphysis pubis. The tape is passed around the hip from the side.

**Suggestions**

1. Handling of anthropometric tools is essential for the easier measurements from the subjects.
2. Understanding of anthropometric points makes easier the process.

**Observations from the survey**

From the survey conducted from 7th August to 14th August, 2019 at TNPESU working model to conduct the questionnaire and anthropometric survey and foot scanning using foot scanner instrument has been derived. It takes minimum of 20 minutes to complete questionnaire survey with one person to understand and answer all the questions. Questionnaire is designed to collect each and every information about the sports and the shoes being used. Further the methodology of face to face survey is found to be successful and will be continued. The subjects are found to be not familiar with the technical terms related to footwear. Based on the questionnaire survey conducted with 102 sports personnel as on today some of the questions will be refined and also will be prepared in bilingual form (English and Tamil).

For whole body anthropometric measurements and foot scanning, it is observed that the subjects are volunteering with interest and cooperating to their best to obtain accurate data. With their kind cooperation and understanding about the study, whole body anthropometric measurements and scanning of foot (both left and right) can be completed for about 100 subjects per week by contributing four hours per day by three teams with minimum 2 members in each team.

This working model as created for the survey at TNPESU will be further improvised and validated in another batch of survey in terms of timeline, protocol and data collection procedure and processing.
CHORD and PPBDD has been conducting a monthly program - Organizational Human Resource Development (O-HRD) to provide training to the staff members on various aspects of critical importance. Under this activity, workshops are conducted for the benefit of Research fellows, M. Tech Students, Staff of CSIR-CLRI, at a frequency of one workshop a month. The details of workshops conducted so far are provided below.

Workshop on THINKING SKILLS held on 29th May 2019

Workshop on SCIENTIFIC PUBLICATIONS held on 28th June 2019

Workshop on PROJECT MANAGEMENT OVERVIEW held on 28th August 2019
Seminar on “Machines for Leather Products”

Seminar on “Machines for Leather Products” delivered by Mr. AXEL ZANGERIE, German Expert, M/S PFAFF on 30th August 2019 at B.M.Das Hall for the students and staff members of CLRI.

The expert shared his expertise on sewing machines with advanced level of understanding.

Leather Goods Design Programme

The Indian leather goods industry has been expanding rapidly and its export performance in the last several years is very striking. The ever-growing competitive International market for the manufacture of sophisticated, fashion oriented and value added leather products has necessitated the need for design and quality inputs. To provide quality manpower to the industry Leather goods design programme is being offered at SPDC, CSIR-CLRI which attracted many candidates including industry sponsored. Latest edition of the course (August 2019 batch) commenced on 26th August 2019. Two candidates enrolled for this programme.

Course curriculum of the programme includes:

Pattern designing (Manual)

Introduction to Leather Goods
- Personal leather goods for Men & Women
- Clutch Bag/Shoulder Bag
- Executive products
- Travel/Sports Bag
- CAD for Leather Goods

Introduction to CAD systems
- Pattern Digitizing
- Pattern construction
- Nesting
- Consumption Calculation and Reports
PREMIERE VISION! Destination A/W 20/21 will take us all into the woods, outdoor and in the nature. The message is GREEN and one exhibitor brought the forest on the fairground:

Brown is really getting the NEW black and so do all natural shades of medium browns up to reddish saddle and to spicy and warm fox-orange shades!

It’s excellent and the stage for Leather! Never saw in Trend area of Fabrics & Colours on PV so many leather references. Suppose the nature sensitive trend is also the promotion of one of the most “organic” materials: LEATHER.

A highlight downtown Paris - the window of department store BHV who showed the aquatic world of the ocean/sea with plastic bottles and message of sustainability and recycling:

MICAM, Milano: SS 2020

Animal prints: snake & leopard prints, Braiding, Interlacing, feminine & chic, high heels, colours between flowers and candy, And not only sneakers

Reports from Members of FASHION TREND POOL and MODEUROP who were present at these Fairs is “optimistic.” Let us ring in the new season with gaiety!
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